

JPRS 77449

24 February 1981

USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 79

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

Soviet books and journal articles displaying a copyright notice are reproduced and sold by NTIS with permission of the copyright agency of the Soviet Union. Permission for further reproduction must be obtained from copyright owner.

USSR REPORT
ELECTRONICS AND ELECTRICAL ENGINEERING
No. 79

CONTENTS

AMPLIFIERS

Losses in Push-Pull Low-Frequency Amplifiers With Pulse-Width Modulation.....	1
'See Through' Power Amplifiers Based on Traveling-Wave Tubes.....	1

ANTENNAS

On Partial Phase Center Stability of Rectangular Aperture.....	3
Thermal Radiation of Medium and Noise Temperature of Antennas With Axisymmetric Radiation Pattern.....	4
Calculation of Two-Mode Horn With Thin Dielectric Tube.....	4
Influence of Aperture Distribution Digitization on Antenna Field.....	5
Influence of Various Auxiliary Reflector Fastening Systems on Type ADE Antenna Parameters.....	6
Influence of Combination Interference on Signal-to-Noise Ratio in Phased Array Receiving Antennas With Nearly Linear Channels.....	7
Field Intensity Produced By a Medium-Wave Zenith Antenna at Distances Up to 1700 KM.....	8
Possibility of Compensating for Noise Signals Received on the Side Lobes of the Reception Pattern of Phased Antenna Arrays.....	8

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT WARE: CONTROL, AUTOMATION, TELEMECHANICS, TELEMETERING, MACHINE DESIGNING AND PLANNING

Experience in Using the Dialog Mode for Design of Optical Systems With the Aid of a BESM-6 High-Speed Computer.....	10
---	----

Parametric Synthesis of Solid-State Millimeter-Wave Amplifiers and Oscillators.....	11
Energy-Independent Semiconductor Memory Element Based on a Si-SnO ₂ Heterojunction.....	11
Systems for the Automated Design of Ultralarge-Scale Integrated Circuits.....	12
CERTAIN ASPECTS OF RADIOASTRONOMY, SATELLITES AND SPACE VEHICLES	
Design Principles of High-Speed Phase Modems for Systems With Multistation Access and Time Multiplexing.....	14
Automatic Inspection and Standby in MDVU-40 (Multistation Access and Time Multiplexing) Equipment.....	14
CIRCUIT THEORY AND PRACTICE	
Determination of the Time of Entry Into Synchronism of a Phase Automatic Frequency Control System With an Active Proportional-Integrating Filter.....	16
COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS AND TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA TRANSMISSION AND PROCESSING, INFORMATION THEORY	
Spectral Characteristics of Digital Frequency-Shift Keying Signal.....	17
On Influence of 'Resolving Feedback' on Noise Immunity of Sequential Signal Processing System in Channels With Memory.....	18
Adaptive Pseudonoise Signal Receiver With Optimum Weight Coefficients...	19
Estimation of Noise Immunity and Dynamic Error of Phase-Amplitude Modulation Receiver.....	20
Application of Student's Statistics for Sequential Signal Detection on Background of Noise With Unknown Correlations.....	21
Estimation of Correlation of Input Noise During Analysis of Discrete Synchronization Systems.....	21
Trends in Development of Cables for Digital Transmission Systems (Survey).....	22
More Efficient Utilization of Zonal Single-Quad Cables.....	23
Analysis of Communication Cable Vulnerability to Lightning Discharges...	23

Power of Inaudible Noise During Operation of Many Parallel K-60 Transmission Systems.....	24
The Noise Immunity of an Autocorrelation Digital Demodulator of Frequency Telegraphy Signals.....	24
Statistical Estimation of the Time of Arrival of a Sequence of Optical PPM Pulses.....	25
Estimate of Noise Immunity of Nonparametric Detection of an Optical Signal After Passage Through a Turbulent Atmosphere.....	26
Experimental Study of the Correlation Characteristics of the Noise From Other Stations in Shortwave Radio Channels.....	27
Performance and Applicability Range of a System of Transmission Over a General-Purpose Signalization Channel.....	28
UMG-2 Equipment for Transmission of Service Messages in Automatic Interurban Telephone Exchanges.....	28
Operational Performance Analysis of Automatic Interurban Telephone Exchanges.....	29
Improving the Reliability of Equipment in Automatic Zonal Telephone Exchanges.....	30
Improving the Quality and the Reliability of System K-1920 Transmission Channels.....	30
Modernization of the Model 'Dozhd'-2' UHF FM Transmitter Set.....	31
Maximum Signal-to-Noise Ratio in Reception of Pulse-Time-Modulation Signals.....	31
A Model of Amplitude-Probability Distribution of Smooth Pulse-Modulated Radio Noise.....	32
COMPONENTS AND CIRCUIT ELEMENTS, WAVEGUIDES, CAVITY RESONATORS AND FILTERS	
Performance Features of Rectifiers Working on Nonlinear Loads--Microwave Devices, Triodes and Transistors.....	33
Investigation of Complex Waves of Two-Layer Shielded Wave Guide.....	34
CONFERENCES, SEMINARS, EXHIBITIONS, SYMPOSIUMS	
For Signalers of Karelia and Northern Regions.....	35

CONVERTERS, INVERTERS, TRANSDUCERS

Matching of an Eight-Band Frequency-Division Device.....	36
Experimental Study of Frequency Converters Based on Electron-Transfer Diodes.....	36

ELECTROACOUSTICS

Acoustoelectric Effect in a Metallized Piezoelectric Waveguide.....	38
---	----

ELECTROMAGNETIC WAVE PROPAGATION, ELECTRODYNAMICS

Toward a Theory of Optical Waveguide Modes in a Band Domain Structure.....	39
Analysis of Near Electromagnetic Field in Radiator Aperture for Different Field Phase Distributions.....	40

ELECTRON TUBES: ELECTROVACUUM TECHNOLOGY

Passage of a Signal Through a Traveling-Wave Tube and a Compression Filter.....	41
Performance Calculations for O-Type Devices With Coupled Nonidentical Resonator Circuits Operating in the Linear Mode.....	41
Frequency Characteristics of Intermodulation Oscillations in an O-Type Traveling-Wave Tube During 2-Signal or 3-Signal Amplification.....	42
Possibility of Reducing the Nonlinear Distortion of a Signal in a Wideband Traveling-Wave Tube by Means of a Phase Jump of the Second Field Harmonic.....	43

ENERGY SOURCES

Dielectric-Semiconductor Structures With Schottky Contacts for Photoelectric Conversion.....	44
--	----

INSTRUMENTS, MEASURING DEVICES AND TESTERS, METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

The Status of Metrologic Support of Equipment for Measurement of Amplitude-Modulated Radio Signals.....	45
Statistical Analysis of Typical Measurement Structures of Differential Refractometers.....	46
A Measuring-Computing Complex for Testing of Spectroradiometers.....	46

Estimation of the Interference in Electronic Apparatus Caused by the Application of Dynamic Loads.....	47
Determining the Angular Reflection Function of a Light Reversing Prism...	48
Maximum Capabilities of Wide-Field Spectrometers With Selective Interference.....	49
Spectral Characteristics of Some Filters and Films on Absorbing and Reflecting Substrates.....	49
Sensitivity Fields of Spectral Channels in an Infrared Radiometer and the Possibility of Their Equalization.....	50
A Standard Radiator for Calibration of Pyrometers.....	51
Measurement of Electromagnetic Parameters of Ferrites at Microwave Waveband by the Method of Comparison.....	52
A Procedure for Estimating the Number of Multielectron Scintillations From the Active Screen Surface of an Electrooptical Image Converter.....	52
Use of Heat Probes for Recording of Weak Infrared Pulse Signals.....	53
Linear Photodetectors With Low-Noise Photodiodes.....	54
Scanning Methods for Measurement of the Angular Coordinates of a Point Source.....	54

MICROELECTRONICS

Use of Nematic Liquid Crystals for Visualizing Scattered Electric Fields of Microelectronic Products.....	55
Elementary Cell of a Parallel Multidigit Multiplier of the Integrated Injection Logic (I ² L) Type.....	56
Search for New Physical Phenomena in the Solid State for Use in Microwave Electronics (Survey).....	57
Subnanosecond-Range Integrated Circuits Based on Gallium Arsenide.....	58
Resistivity of Thin Tungsten Films Applied by Sputtering Utilizing a Discharge With Oscillating Electrons.....	59
Recovery Time and Its Relation to the Maximum Power of Solid-State Microwave Protective Devices.....	60
Stray Coupling in Hybrid Film Microcircuits With Finite Dimensions of the Case.....	61

Macromodeling of Analog Integrated Circuits on the Basis of the Method of Basic Models.....	62
Multisectional Model of an Integrated Injection Structure.....	63
OSCILLATORS, MODULATORS, GENERATORS	
Analysis of Starting Currents of a Reflection-Type Diffraction Radiation Generator.....	65
Control of the Frequency of an Ensemble of Autooscillators With an External Resonator.....	65
A Transistor Oscillator for the 3-cm Wavelength Band.....	66
A Semiconductor Oscillator for the Millimeter Wavelength Band With an Open Resonator Cavity and an Excitation System Consisting of Two Bars...	67
PHOTOELECTRIC PHENOMENA AND DEVICES, ELECTROLUMINESCENCE, ION DEVICES	
Analysis of the Frequency and Transient Characteristics of an Optron Made With a Light-Emitting Diode and a Compound Phototransistor.....	68
PRODUCTION TECHNOLOGY	
Glass-to-Silicon Joints in Glass-Metal Instrument Housings.....	69
Use of Adhesives VK-28M and VK-48 in the Manufacture of Fiber Optics.....	69
More Effective Operation of Radio Equipment Manufacturing Enterprises.....	70
RADARS, RADIONAVIGATION AIDS, DIRECTION FINDING, GYROS	
The Effect of Coherent Multipoint Signals on a Single-Pulse Direction Finder.....	71
Relation Between Sensitivity and Effective Range of Autodyne With Radar Parameters.....	72
RECORDERS	
Analysis of Parameters of Magnetic Recording Equipment Using Electronic Computer.....	73
SEMICONDUCTORS AND DIELECTRICS, CRYSTALS IN GENERAL	
Approximate Analysis of the Gunn-Effect Diode Operating Modes.....	74

AMPLIFIERS

UDC 621.375.026:621.376.54

LOSSES IN PUSH-PULL LOW-FREQUENCY AMPLIFIERS WITH PULSE-WIDTH MODULATION

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 80-82 manuscript received 5 Aug 79

ALEKSANYAN, A. A., and GALAKHOV, V. A.

[Abstract] Highly effective push-pull low-frequency amplifiers have been produced. However, in most known amplifiers the efficiency varies with the frequency of the signal amplified. This phenomenon is explained and quantitatively estimated. The phase shift of voltage across the load of such an amplifier leads to the appearance of voltage across the coupling capacitor between the two halves of the circuit at the moments of the switching of the transistors. This creates conditions for inverted connection of the output transistors, allowing the coupling capacitor to discharge through these transistors. The losses resulting from switching of the capacitor are estimated, considering only the first harmonic of the voltage at the input of the low-pass filter. The calculated and experimental variations in efficiency with signal frequency are compared and found to agree quite well. They demonstrate that losses in the amplifier at frequencies close to the cutoff frequency of the low-pass filter may be significantly greater than losses at lower frequencies. Figures 2; references: 4 Russian.
[85-6508]

UDC 621.385.632

'SEE THROUGH' POWER AMPLIFIERS BASED ON TRAVELING-WAVE TUBES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 36-42 manuscript received 7 Dec 79

KALININ, Yu. A. and KATS, A. M.

[Abstract] "See through" traveling-wave tubes features a very efficient conversion of direct-current energy to high-frequency energy at a relatively low gain. This is caused by a better bunching of electrons in the large-amplitude field, entrapment of a high-density bunch in the retarding phase of the field and uniform interaction of all layers in the electron beam with the traveling wave. On the other hand, there

is a large second current harmonic, although a not so large second power harmonic, in the spectrum of the output signal without a second harmonic in the input signal. This is largely caused by a higher degree of asynchronism at double frequency. The efficiency of such a tube is high, because of low no-beam losses, and it depends more critically on the distributed losses. All these characteristics make "see through" traveling-wave tubes suitable as output amplifiers and decouplers or phase compensators. The major design problems include beam shaping and energy recovery as well as minimization of the heat load on the retarding system. If necessary, the gain can also be increased, a gain of over two octaves being attainable with the use of nonhomogeneous retarding systems. An overall efficiency up to 55% or even 70% is possible with single-stage and 3-stage energy recovery, respectively, the electronic efficiency correspondingly being 35-37%. Figures 4; references 8: 7 Russian, 1 Western.

[93-2415]

ON PARTIAL PHASE CENTER STABILITY OF RECTANGULAR APERTURE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 68-70 manuscript received 10 Mar 80

KRITSYN, V. A. and CHEBOTAREV, S. A.

[Abstract] Because the wave surface of real antennas is usually aspherical and there is no point phase center, a partial phase center is introduced through the cross sections of the wave surface on planes passing through the radiation axis, and the evolute of a rectangular aperture is analyzed for important field distributions in cross sections of the wave surface cut by the coordinate planes. The aperture field distribution is assumed to be described by a real function. Functions that depend on the real and imaginary parts of the radiation pattern and on their derivatives are used. Formulas are given for determining the coordinates of the partial phase center through the derivatives of the phase pattern. The evolute structure is examined in certain special cases, which are important in practical applications. A formula is given for the field distribution on the assumption of cophasal waves. The coordinates of the phase center are calculated and the evolutes corresponding to them are plotted. The evolute is examined for the case of a quadratic phase distribution on the assumption that the amplitude distribution is an even function. The results of the studies show that a few points of the real and imaginary parts of the field distribution determine the characteristics of the phase center of the aperture. The relations derived in the study can be used for calculating the coordinates of the phase center of the aperture and for analyzing its stability for the most important field distributions. Figures 2; references: 2 Russian.
[69-7872]

THERMAL RADIATION OF MEDIUM AND NOISE TEMPERATURE OF ANTENNAS WITH AXISYMMETRIC RADIATION PATTERN

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 77-80 manuscript received 2 Feb 80

SOMOV, A. M.

[Abstract] Because it is desirable in calculations to use the real noise temperature of a medium, the noise temperature of an antenna with an axisymmetric radiation pattern is determined with the real noise temperature of the propagation medium taken into consideration. Equations are given for determining in spherical coordinates the real noise temperature of the atmosphere at the zenith and on the horizon. The real noise temperature of the earth's surface is determined for vertical and horizontal polarization of thermal radiation. A formula is given for soils of moderate and high humidity in the microwave band. Expressions are given for the real noise temperature of the atmosphere after reflection from the earth's surface for vertical and horizontal polarization of atmospheric thermal radiation, reflected by the earth's surface. The real noise temperature of the atmosphere, reflected from the earth's surface in dry, clear weather is plotted as functions of angles θ and α for vertical and horizontal polarization. A 25-meter main reflector was used for testing the feasibility of using the proposed procedure in the 4 GHz band. Figures 4; references: 7 Russian. [69-7872]

CALCULATION OF TWO-MODE HORN WITH THIN DIELECTRIC TUBE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 80-82 manuscript received 15 Jan 80

ABRAMOV, V. I.

[Abstract] A procedure for calculating the basic dimensions of a thin dielectric tube (TDT) on the basis of experimental analyses is explained, and the radiation patterns of horns, calculated by the proposed procedure, are given in order to calculate the driver of a horn with a TDT. A two-mode horn with a TDT is illustrated. For specific horn dimensions, the amplitude-phase relations of H_{11} and E_{11} waves in the aperture depend on the dielectric constant, length and thickness of the tube and on the location of the center. A simplified model of a TDT in the form of two E_{11} wave generators is examined. An equation is given for calculating the complex field amplitude of the E_{11} wave with a TDT in an arbitrary position. The amplitude of the

E_{11} wave in the aperture depends on the size and dielectric constant of the TDT and the phase depends on the distance to the center of the tube. The procedure was used for calculating and tuning two horns with TDT with aperture diameters of 1.75λ and 4λ . The basic parameters of the horns are given. The width of the radiation pattern on different levels in the E and H planes and the first side lobe level in the E plane are plotted as functions of frequency. The proposed technique can be used for calculating two-mode horns with TDT. The author thanks I. F. Belov for attention to the work and valuable comments. Figures 3; references 7: 1 Russian, 6 Western (1 in translation).
[69-7872]

UDC 621.396.67.001.24

INFLUENCE OF APERTURE DISTRIBUTION DIGITIZATION ON ANTENNA FIELD

Moscow *RADIOTEKHNIKA* in Russian Vol 35, No 9, 1980 pp 63-64 manuscript received 22 Feb 80

MAKSIMOV, S. I., NOVIKOV, V. I. and TSARYUK, D. A.

[Abstract] How well the function $F(u)$ approximates the function $F(u)$ as a function of the digitization step, and the possibility of refining the true radiation pattern if the behavior of the integrand function at the digitization points is known, are determined with the aid of the theory of enveloping asymptotic series in accordance with the Euler-Maclaurin law. The digitization step of the amplitude-phase distribution of the near field is selected on the basis of V. A. Kotel'nikov's theorem. Physical limitations, inherent to the real amplitude-phase distribution measurement process, lead to a Fourier transform in finite limits. The spectrum of integrand function $f(x)$ is unlimited and the application of Kotel'nikov's theorem leads to a finite digitization error. In many cases a knowledge of the behavior of the integrand function on the edges of the integration range can help to increase the accuracy of approximation of $F(u)$. The described method is most effective in cases when the accuracy of approximation of $F(u)$ with the aid of the digital Fourier transform is limited by the computer memory capacity. Figures 1; references 6: 5 Russian, 1 Western (in translation).
[69-7872]

INFLUENCE OF VARIOUS AUXILIARY REFLECTOR FASTENING SYSTEMS ON TYPE ADE ANTENNA PARAMETERS

Moscow *RADIOTEKHNIKA* in Russian Vol 35, No 9, 1980 pp 84-87 manuscript received 12 Mar 80

BUZUYEV, Yu. B., YERUKHMOVICH, Yu. A., LITINSKIY, O. A. and TIMOFEYEVA, A. A.

[Abstract] The influence of several kinds of auxiliary reflector fastening systems on type ADE antenna parameters is examined in studies conducted on a type ADE-1 antenna, operating in the 11 GHz band. The parameters of the antenna are given. The designs of the investigated fastening systems are illustrated. One fastening system consists of four glass textolite tie bolts. Polyurethane foam is used in another kind, in which the air-dielectric interface is conical, and in another case it is a perfect toroid with a special wall profile. In the first kind there are no thermal losses and the fastening system exerts little influence on antenna-feed matching, but the irradiator or entire antenna must be covered with a radio-transparent enclosure in order to protect it from the atmosphere, and the side lobe radiation level is excessive. The second kind of fastening system simultaneously performs two functions--it covers and seals the radiator, and performs precise alignment. Possible drawbacks are thermal losses and influence on electrical characteristics. The results of measurements of the coefficient of reflection from the feed input are plotted as functions of frequency. The results of the calculations show that the feed is better matched with a toroidal fastener than with a conical one. Snow on the cone has a considerable effect on the reflection coefficient, whereas snow on the toroid has virtually no influence. The results of measurement in the front half-space on 10.7 GHz of the radiation pattern of an antenna in the horizontal plane, where the fastening system makes a considerable contribution to side lobe radiation, are presented. The results of the investigation indicate that two kinds of fastening systems should be used for the irradiator in an ADE antenna: a complete polyurethane foam fiberglass-reinforced toroid with specially profiled outer and inner air-dielectric interfaces, and full or partial filling of the space between the horn walls and surface of the auxiliary reflector with polyurethane foam. In the latter case the outer surface is specially profiled and must be reinforced with fiberglass. Figures 5; references 4: 2 Russian, 2 Western.

[69-7872]

INFLUENCE OF COMBINATION INTERFERENCE ON SIGNAL-TO-NOISE RATIO IN PHASED ARRAY RECEIVING ANTENNAS WITH NEARLY LINEAR CHANNELS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 71-75 manuscript received 17 Mar 80

GORSHKOV, V. I. and KOROLEV, V. I.

[Abstract] The influence of combination interference, generated in pattern generating channels with little nonlinearity, on the signal-to-noise ratio of a typical phased array antenna (PAA) is analyzed because the noise immunity of receiving PAA, operating under conditions of high saturation by sources of radio emissions, depends to a great extent on the nonlinearity of the pattern generating channels. The pattern generators consist of linear quadrupoles and nonlinear inertialess linear quadrupoles. An equation is given for estimating the transfer function of these quadrupoles. The frequencies of second- and third-order combination interference and the dynamic range of a nonlinear quadrupole in terms of combination interference are determined. The nonlinearity coefficients of series-connected quadrupoles depend on the order in which they are connected. The second- and third-order dynamic ranges depend little on the number of channels, and their dependence on the field distribution of an array for channels with equal nonlinearity coefficients is determined by the noise factor. The structures of one-dimensional and two-dimensional arrays are illustrated and their dynamic ranges are found. The dynamic range of typical phased array antennas is determined basically by the dynamic range of the antenna amplifiers, by the isolation of the amplifiers and by the dependence of the array noise factor on the field distribution, but not on the attenuation in the input attenuators. A means of reducing the influence of combination interference on the signal-to-noise ratio is examined. Expressions are given for determining the optimum attenuation in the given noise situation as a consideration of nonlinearity for the maximum signal-to-noise ratio. Figures 4; tables 1; references: 2 Russian. [69-7872]

FIELD INTENSITY PRODUCED BY A MEDIUM-WAVE ZENITH ANTENNA AT DISTANCES UP TO 1700 KM

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 41-43 manuscript received 11 Sep 79

SHLYUGER, I. S., KAKUZIN, D. I., RAKOV, A. S. and IVANOV, G. V.

[Abstract] The field intensity produced at night by a medium-wave horizontal-polarization zenith-directional antenna was measured in January 1978 at four distances from it: 700 km south, 780 km south, 1400 km east, and 1650 km west. Readings were obtained with FSM-6 comparators and with a loop antenna responding to the linear component of an elliptically polarized wave. The data were then combined, for a more complete evaluation, with data which had been obtained in January 1963 at the distances 200 km south and 360 km south of a similar antenna. As a result, a general curve of field attenuation with distance could be plotted. For reference are also shown here various CCIR attenuation curves for the 50° northern latitude, obtained for several other types of antennas, and an attenuation curve for a horizontal-polarization antenna in the Beromuenster station (Switzerland). Measurements in this study and in Beromuenster were made at frequencies of 1350 and 1562 kHz respectively, the field distribution pattern found to be different in each case. The authors are grateful to coworkers of the measuring points of the Center of Engineering Radio Supervision, who fulfilled measurement of the field intensity, as well as to N. M. Chernyshev, who took part in the processing of materials. Figures 3; tables 1; references 4: 2 Russian, 2 Western.
[54-2415]

POSSIBILITY OF COMPENSATING FOR NOISE SIGNALS RECEIVED ON THE SIDE LOBES OF THE RECEPTION PATTERN OF PHASED ANTENNA ARRAYS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 15-26 manuscript received after abridgment 12 May 80

ZHIBURTOVICH, N. Yu.

[Abstract] This review, based on materials appearing in the non-Soviet literature, discusses adaptive antenna arrays. A distinction is made between fully adaptive antenna arrays, in which adaptive regulation of the weight coefficients of the amplifiers connected to each element of the array occurs, multichannel autocompensator arrays, in which the number of regulated amplifiers does not exceed 10% of the total number of array elements, and adaptive antenna arrays with partial adaptation, in which 10 to 50% of the total number of amplifiers are regulated to construct the weight coefficients. The algorithm used to calculate the optimal weight factors is very important in such arrays. Adaptation algorithms are compared. The types

compared include recurrent algorithms, gradient algorithms, and random search algorithms. Serious difficulties are encountered in attempting to construct optimal adaptive antenna arrays, including the difficulty of computation of the algorithm, particularly where the number of array elements is over 4000, as well as the high cost of the adaptation system. Therefore, several types of quasi-optimal adaptation systems are discussed, including adaptive antenna arrays with phase adaptation control and arrays with partial adaptation. It is concluded that the optimal solution to the problem of suppressing noise is to introduce the principle of adaptation of signal processing systems at the very beginning of the planning stage. Gradient algorithms using correlation feedback, while quite effective, are also very simple to realize in hardware. Protection of the useful signal from distortions is one of the most important problems encountered in the development of AAA; methods for this protection must be based on difference in the characteristics of signals and noise and are embodied as limitations in the number of degrees of freedom of the AAA. The simplest effective methods utilize time and frequency differences between the signal and noise. Quasi-optimal AAA with either purely phase control or partial adaptation are promising, achieving relatively high levels of noise suppression while simplifying design and reducing cost. Figures 9; references 23: 9 Russian, 14 Western. [85-6508]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT WARE: CONTROL,
AUTOMATION, TELEMECHANICS, TELEMETERING, MACHINE DESIGNING AND PLANNING

UDC 535.317.2

EXPERIENCE IN USING THE DIALOG MODE FOR DESIGN OF OPTICAL SYSTEMS WITH THE AID OF A
BESM-6 HIGH-SPEED COMPUTER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 80 pp 21-22
manuscript received 25 Mar 80

GRAMMATIN, A. P. and DEGEN, A. B.

[Abstract] A dialog system on the basis of a BESM-6 high-speed computer has been set up for design of optical systems. Peripheral equipment includes a VT 340 "Videoton" alphanumeric display, a graphic display, and a graph plotter. Data are recorded in a conventional manner without special symbols, the dialog between engineer and machine does not require a special language or special instructions, the results are displayed on the VT 340 screen without exceeding its capacity, and verification and error detection are automatic. The dialog uses available and updated programs for calculating also the product sensitivity to manufacturing imprecision, third-order aberrations, aberrations and paraxial characteristics of the front components, refractive indexes of glasses and other optical materials, for addition or elimination of surfaces from the optical system without transcription of structural components, and for transition from specifying radii to specifying paraxial angles and vice versa. This dialog system has proved itself most effectively in design of simple and medium-complex optical systems without fundamentally novel features. It is being further improved for more advanced tasks such as calculating, with sufficient speed, the frequency-contrast characteristics. References: 3 Russian.
[98-2415]

PARAMETRIC SYNTHESIS OF SOLID-STATE MILLIMETER-WAVE AMPLIFIERS AND OSCILLATORS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 24-31 manuscript received 20 May 80, after revision 23 Jun 80

KOTSERZHINSKIY, B. A., PARFENOV, A. A. and RADETSKIY, Yu. L.

[Abstract] Parametric synthesis is successfully used, with the aid of a computer, for design and optimization of solid-state millimeter-wave amplifiers and oscillators. One algorithm is shown according to which a reflection-type coaxial-waveguide amplifier can be designed for tuning with a plunger and its performance, including amplitude-frequency characteristic and stability range, optimized upon selection of the appropriate target function. Another algorithm is shown according to which an oscillator can be designed and optimized for a given nominal power output at a given operating frequency. Both algorithms have been programmed on a Unified System YeS 1022 computer. Such a design, as that of typically a 100 mW - 30 GHz oscillator, encompasses the topology of the electrodynamic system and the internal structure of the active device inside the housing. Figures 7; tables 3; references 13: 4 Russian, 9 Western.

[93-2415]

ENERGY-INDEPENDENT SEMICONDUCTOR MEMORY ELEMENT BASED ON A Si-SnO₂ HETEROJUNCTION

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 470-473 manuscript received 15 Nov 79

MAD'YAROV, M. R., TERESHIN, S. A. and POKALYAKIN, V. I.

[Abstract] Utilization of the switching and storage effect in heterostructures is under investigation for the purpose of creating energy-independent semiconductor storage devices. Here some preliminary results are given of an investigation of the properties and parameters of a model energy-independent storage element based on a monocrystalline Si - SnO₂ film heterojunction. SnO₂ was chosen for its chemical stability, ease of production and compatibility with integrated circuit technology and the ability to vary extensively its conduction. The reactive ion-plasma sputtering method described in an earlier study (1977) was employed, using a target of pure tin in an atmosphere of oxygen. A modified series-produced type URM unit was used and heating of the substrate was regulated over a range of 150 to 400° C with a partial oxygen pressure of $(1 \text{ to } 2) \cdot 10^{-4}$ mm Hg. The models studied were fabricated with silicon substrates with a (111) orientation made of materials with n and p conduction with a carrier concentration of 10^{16} to 10^{19} cm⁻³. The silicon wafer, before spraying the film, underwent a special chemical treatment compatible with

standard integrated circuit technology. The upper metal electrodes about 0.4 mm^2 in area were produced by the method of thermal spraying under vacuum. Electron microscopic investigations demonstrated that the SnO_2 films produced were polycrystalline over the thickness range of 500 to 2000 Å with grains measuring 100 to 3000 Å. A typical electron diffraction pattern is shown. It was demonstrated that the properties of Si- SnO_2 -Me (metal) heterostructures depend substantially on many parameters of the elements making up the structure, such as the area of the metal electrode, the thickness and electrical conductivity of the SnO_2 film, the type of conduction and the degree of alloying of the silicon substrate. With conditions for the process for producing SnO_2 and parameters of the substrate close to optimal, the switching and storage effect is observed for all diodes on the wafer without exception and the spread in switching parameters over the wafer was not greater than 20%. Optimal conditions for the process were a substrate temperature of about 300°C and an oxygen pressure of about $1 \cdot 10^{-4} \text{ mm Hg}$. A volt-ampere characteristic is provided for a model with an SnO_2 film approximately 1500 Å thick and a p-Si resistivity of about 0.005 ohm-centimeter. The required effect is observed only for p-type substrates with a hole concentration of not less than 10^{18} cm^{-3} . The switching effect also disappeared with conductivity of the SnO_2 film greater than $1 \Omega^{-1} \cdot \text{cm}^{-1}$. A study was made of the duration of storage by an element in each of its states. An element of the type described with an upper electrode made of gold can store entered data for more than 2 months without a noticeable change in resistivity. After this the resistivity increases slowly for a period of many months. It is concluded that for the structure studied here the switching and storage effect is apparently not associated with mass transfer of the material of the metallic electrodes, as was previously thought. Figures 3; references 8: 3 Russian, 5 Western.

[35-8831]

UDC 621.382.8.001.2

SYSTEMS FOR THE AUTOMATED DESIGN OF ULTRALARGE-SCALE INTEGRATED CIRCUITS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 401-412 manuscript received 17 Jan 80

BATALOV, B. V. and NORENKOV, I. P.

[Abstract] Existing systems for the automated design (SAPR's) of large-scale integrated circuits can only be used for solving some problems relating to the design of ultralarge-scale integrated circuits (ULSIC's) and these problems are often solved inefficiently with a great amount of time spent and with insufficient accuracy. The question is discussed here of creating SAPR's which takes into account the specifics of ultralarge-scale integrated circuits. SAPR's for ULSIC's must include an advanced subsystem for designing functional and logical circuits for devices to be implemented in the form of ULSIC's. This subsystem is especially important in designing special-purpose ULSIC's. The design of ULSIC's requires hardware constructed according to the hierarchical principle with not less than two levels: the central computing complex level and the automated work place level. The

central computing complex should have a multimachine or multiprocessor computing system with an operating speed of about 10^7 operations per second and higher and a main memory capacity of not less than several megabytes. The automated work places must be distinctly oriented toward use in a specific subsystem of the SAPR and must provide for convenient interaction between developers and the computer. An important part of the hardware is the information and measuring system for gathering data on the parameters of circuits and their elements. Reduction of the dimensions of elements of ULSIC's results in an increase in the dimensionality of problems to be solved and intensifies the difficulties involved in designing the topology of ULSIC's. Outlines of the topology must be created automatically and algorithms must be developed in order to go from an outline to a general form. Extensive use must be made of macromodels of fragments of ULSIC's and of algorithms for a speedy solution to equations in analyzing basic electrical circuits. The problem of improving software for designing circuitry and the topology of ULSIC's is a crucial one for the development of SAPR's. From the viewpoint of software, SAPR's for ULSIC's contain four subsystems: 1) Functional and logic design; 2) Design of semiconductor structures and elements of ULSIC's; 3) Circuitry design; and 4) Topological design. Each subsystem uses its own language for describing data, translators and dialog system. At present analysis software is the most highly developed in all SAPR subsystems. The hierarchical principle and fragmentation are used in designing mathematical models for ULSIC's. A great amount of software for various optimization methods is an important need. The problem of automatic structural synthesis has not been solved for practically any single subsystem. Features of each subsystem of an SAPR for ULSIC's are discussed individually. In the circuitry design subsystem improvement of macromodeling procedures is a crucial problem. In the area of optimizing electronic circuits it is necessary to use combined implicit and explicit integration equations. Aspects of the development of software for SAPR's are discussed and an illustration is given of the structure of applied software. Figures 2; references 13: 11 Russian, 2 Western.

[35-8831]

CERTAIN ASPECTS OF RADIOASTRONOMY, SATELLITES AND SPACE VEHICLES

UDC 621.396.946.2:621.396.6

DESIGN PRINCIPLES OF HIGH-SPEED PHASE MODEMS FOR SYSTEMS WITH MULTISTATION ACCESS AND TIME MULTIPLEXING

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 46-51 manuscript received 2 Jul 79

EUSYREV, S. Ye., DOROFYEV, V. M., PAYANSKAYA, M. L. and CHEKHOVSKAYA, D. M.

[Abstract] The design of phase modems for transmission of digital data with multistation access and time multiplexing (MDVU) in satellite communication systems is considered in the light of the stringent high-speed and low-noise requirements for this application. Such a modem consists of a modulator, essentially a controlled switch with logic and one band-pass or two low-pass filters, and a demodulator consisting of a detector with an integrator or filters and a signal waveform restorer. It also includes carrier-frequency recovery and clock-frequency recovery, both in parallel and independent of the phase-modulation detector. Here a modem is described with low-pass filters and with code conversion, absolute-to-relative and relative-to-absolute respectively, in the modulator and in the demodulator, and with carrier-frequency recovery by means of a remodulator and a band-pass filter. It has been designed for a speed of 40 Mbits/s, but all functional components are the same in 20 Mbits/s and 60 Mbits/s modems. Figures 7; references 6: 2 Russian, 4 Western. [54-2415]

UDC 621.396.946.2:621.396.6

AUTOMATIC INSPECTION AND STANDBY IN MDVU-40 (MULTISTATION ACCESS AND TIME MULTIPLEXING) EQUIPMENT

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 52-54 manuscript received 2 Jul 79

GUDENKO, D. V., PAN'KOV, G. Kh., PAUK, A. G. and TSIRLIN, V. M.

[Abstract] In multistation-access satellite communication systems with time multiplexing (MDVU) and a relay in orbit, where division of signals from ground stations is achieved by their mutual synchronization, there is usually one master station which sets the frame frequency. MDVU-40 equipment facilitates simultaneous operation of up to 36 stations through a single relay trunk, reliability being achieved by means of an automatic inspection and standby system. Failure of the master

station is most serious and "spatial" standby ensures that in case of its failure, caused by weather conditions, loss of power, or human error, a local station in another weather zone or supplied from a different power source will take over. Standby is also provided for the transmitting-receiving equipment in each ground station. Failure and clearance of failure are determined on the basis of signals coming from channel service equipment and combining elements of a 4-variable 2-state matrix. An algorithm of automatic standby switching according to this principle is proposed which can be implemented by a processor with four decoders and a variable time delay. Implementation of this algorithm should make feasible unattended operation of ground stations. Figures 4; tables 1; references: 1 Russian.
[54-2415]

DETERMINATION OF THE TIME OF ENTRY INTO SYNCHRONISM OF A PHASE AUTOMATIC FREQUENCY CONTROL SYSTEM WITH AN ACTIVE PROPORTIONAL-INTEGRATING FILTER

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 29-31 manuscript received 15 Nov 79

KHMEL'NITSKIY, V. S.

[Abstract] A study is made of the transient process in a phase automatic frequency control (PAFC) system which uses an active proportional integrating filter. The variation in the time of entry of the system into synchronism as a function of the parameters of this filter and the initial frequency mistune is determined by the method of averaging. A schematic diagram is presented of the filter, which is based on an operational amplifier. An equation is produced for the PAFC system, converted to a system of algebraic equations and differentiated with respect to dimensionless time. It is assumed that the voltage across the filter capacitor is equal to 0 at the beginning of the reference time, leading to an initial condition which defines the transient process. It is shown that the system can then be calculated by the method of averaging without close restrictions. Two numerical examples are appended. Figures 1; references: 2 Russian.
[85-6508]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS AND
TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA TRANSMISSION
AND PROCESSING, INFORMATION THEORY

UDC 621.3.037.372:621.376.52

SPECTRAL CHARACTERISTICS OF DIGITAL FREQUENCY-SHIFT KEYING SIGNAL

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 30-33 manuscript received
30 Oct 79

FADEYEV, A. N. and GORYACHEV, A. A.

[Abstract] Because the spectral characteristics of a digital frequency-shift keying (FSK) signal deteriorate when an FSK signal is approximated by a PSK [phase shift-keying] signal with equidistant phase shifts, the basic spectral characteristics--out of band radiation level, bandwidth and short-term frequency instability--are analyzed as functions of the number of phase gradations and modulation index. A periodic sequence of pulses of equal duration and with unit amplitude and push and release frequencies is used as a model of an FSK signal for computing the spectrum of a digital FSK signal. An analytical equation is given that describes the signal. The phase-time characteristic of the digital FSK signal is illustrated. Equations are given for analyzing particular phase shifts and for determining the maximum out of band radiation level. The International Radio Consultative Committee energy definition is used for calculating the spectral width of a digital FSK signal. The normalized spectral width of a digital FSK signal is plotted. A formula is derived for calculating the short-term frequency instability. On the basis of the results it is possible to select the number of phase gradations for a given modulation index and required spectral characteristics. Figures 3; references: 5 Russian.
[69-7872]

ON INFLUENCE OF 'RESOLVING FEEDBACK' ON NOISE IMMUNITY OF SEQUENTIAL SIGNAL PROCESSING SYSTEM IN CHANNELS WITH MEMORY

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 22-25 manuscript received 5 Sep 79

KARTASHEVSKIY, V. G., KLOVSKIY, D. D. and NIKOLAYEV, B. I.

[Abstract] The influence of resolving feedback on the process of grouping and multiplication of receiver output errors for high-speed sequential systems is of special importance when the memory of a channel which causes between-symbol interference can reach rather large values. Because of this, in addition to the unconditional error probability, or mean error probability per symbol, there is a need to compute the conditional error probabilities which express the appearance at the receiver output of chains of erroneous decisions of a certain length and configuration. Here the conditional error probabilities in a sequential system with resolving feedback are analyzed. The system operates in a channel with adaptive Gaussian white noise by a processing algorithm that entirely utilizes element-by-element decision making. The algorithm is expressed analytically through binary code with the use of opposite signals. The conditional error probabilities for separate beams of identical intensity and the noise immunity of the optimum B. A. Kotel'nikov receiver are plotted. The energy loss of the examined receiver with real feedback, functioning in the described channel for the worst case, is 2.5 dB. The noise immunity curves of a demodulator with perfect feedback differ little in the examined channel from the noise immunity curve of the optimum B. A. Kotel'nikov receiver. The performance quality of a receiver with real resolving feedback depends on the probability properties of the transmitted binary information, and the receiver noise immunity, given approximately equiprobable symbols on the transmitting end, is determined by the noise immunity of the signal processing algorithm that is utilized. Figures 1; references 5: 3 Russian, 2 Western (1 in translation). [69-7872]

ADAPTIVE PSEUDONOISE SIGNAL RECEIVER WITH OPTIMUM WEIGHT COEFFICIENTS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 3-8 manuscript received 29 May 79

VARAKIN, L. Ye. and TALYZIN, V. N.

[Abstract] Because of the special importance of protecting pseudonoise communications systems from strong selective interference there is a need to design an adaptive pseudonoise signal receiver that performs adaptation with the optimum weight coefficients without preseparation of the signal and interference at the receiver input. The noise immunity of such a receiver and the losses that occur in it during operation are analyzed. An equation is given that expresses the optimum weight coefficients through the powers of the matched filter input signal and interference. The signal and interference components are measured separately. When set in the optimum way the weight coefficients are proportional to the ratio of the signal amplitude to the interference power at the output of the channel element matched filter. A functional diagram of the multichannel adaptive pseudonoise receiver is presented. The signal and interference are fed simultaneously to the inputs of the information and meter channel. An information channel consists of a matched filter and amplifier, the gain of which is proportional to the weight coefficient as computed by the meter channel. The information channel output voltage is accumulated coherently in an adder. Every m -th meter channel consists of a bandpass filter, which extracts the frequency band corresponding to a given channel, and a quadratic detector, on whose output is formed the square of the envelope of the input process. The quadratic detector output voltage goes to circuits that measure the sampled mean and sampled dispersion of the square of the envelope. Equations are given that describe models of the signal and interference. Real situations that can arise during reception, when interference is uniformly distributed among the channels or differs substantially in certain receiving channels, are examined in order to estimate losses in the output signal-to-noise ratio and to determine the conditions that minimize them. The uniform and nonuniform distribution of interference between channels are analyzed. Ten to 15 channels are necessary in order to assure dependable reception. The examined receiver performs the optimum bleaching of the input process without separating the signal and interference components and has a nearly potential noise immunity. Figures 4; references: 5 Russian.
[69-7872]

ESTIMATION OF NOISE IMMUNITY AND DYNAMIC ERROR OF PHASE-AMPLITUDE MODULATION RECEIVER

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 38-41 manuscript received 12 Aug 79

BRONNIKOV, V. N.

[Abstract] The comparative noise immunity of phase-amplitude modulation is evaluated and the specific distortions for this message transmission technique are analyzed in order to determine the position this kind of modulation occupies among other kinds of modulation for the purpose of improving the utilization efficiency of the passband of a communications channel. A simplified functional diagram of a phase communications system is illustrated, in which not a message itself, but samples of it are transmitted directly. The message is regenerated in the receiver by means of interpolation of the samples. To transmit samples, a message is converted to a step-wise or piece-wise constant signal with a certain step duration. Samples are taken in accordance with Kotel'nikov's theorem with a certain digitization step. The output signal of the message converter performs phase modulation of the harmonic signal in the phase modulator. The result is a sequence of pulses with a fixed duration. A modulation index of about 2.5 is used for reducing the threshold properties of the channel. This gives a PAM signal considerably narrower bandwidth than a PSK or FSK signal with the same modulation index. The generalized gain of peak power of a PAM transmitter is determined. The receiver output signal-to-noise ratio is determined by the part of the phase detector output signal that coincides in time with gate pulses. Trigonometric equations are given for calculating the additive signal and noise mixture, amplitude of the gate output pulse, average specific gate output signal and interference powers. PAM provides a generalized gain in transmitter power of 5 dB in just fluctuation interference without consideration of distortions caused by dynamic error and interpolation error. The systematic nature of the dynamic error indicates that it can be reduced without expanding the channel passband by means of compensation, which reduces the dynamic error by 10-20 dB. The message transmission technique described can be modernized by introducing frequency shift keying by transmitting positive and negative values on different carriers, which increases noise immunity by an additional 6 dB by virtue of doubling of the signal bandwidth. The resulting generalized gain in transmitter peak power is about 11 dB as a result of quadrupling the signal spectrum in relation to the message spectrum. Figures 3; references: 7 Russian.
[69-7872]

APPLICATION OF STUDENT'S STATISTICS FOR SEQUENTIAL SIGNAL DETECTION ON BACKGROUND OF NOISE WITH UNKNOWN CORRELATIONS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 53-56 manuscript received 17 Sep 79

SHLOMA, A. M. and GOL'FEL'D, G. B.

[Abstract] In order to stabilize false alarm probability, student's statistics are applied to the sequential detection of signals on a background of interference with unknown correlations for the case of multichannel sequential detection of coherent fluctuating signals on a background of nonstationary normal interference. Student's t -statistics with invariant properties, whose distribution does not depend on the unknown dispersion, are used for the given statement. A sequential criterion of the Wald probability ratio is derived. A modified criterion with a variable lower threshold may be used to reduce the mean detection time, which is most important in radar problems, when most of the scanning time is occupied by the examination of vacant angular positions. The detection problem is examined in two variations, in one of which the sample elements of the observation matrix are independent, and in the other of which the elements of the sample matrix are dependent. The mean detection time is determined for a model in which the observations are stationary in time. The application of the procedure under conditions of a priori uncertainty is examined for the case when the signal to noise ratio is unknown at each moment of time. A procedure is explained, which can be used for detecting a fluctuating signal on a background of passive interference by the multifrequency method in moving target selectors. References 4: 1 Russian, 3 Western (in translation). [69-7872]

ESTIMATION OF CORRELATION OF INPUT NOISE DURING ANALYSIS OF DISCRETE SYNCHRONIZATION SYSTEMS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 50-53 manuscript received 9 Jan 80

GAVRILYUK, M. S. and SHEVCHENKO, Yu. V.

[Abstract] During analyses of the filtering properties of pulsed and digital phase-locked loop systems, an attempt to avoid approximating the input process by white noise and to calculate the correlation of a real process necessitates the determination of the statistical characteristics of a Markov sequence, generated by an $n + 1$ variate Markov vector of states. Therefore systems are examined, in which the

correlation function does not depend on the error. A new model is described, which permits consideration of the correlation of input noise. The noise process is expressed as the equivalent discrete white noise with unit intensity, which does not enter into the argument of the nonlinear function. The model makes it possible to use published results for analyzing systems with correlated input noise. The correlation of input noise in the stationary mode in a system with high filtering capacity is easiest to consider. An example is given of the calculation of the correlation of input noise of a first-order pulsed phase-locked loop system. The dispersion of the phase error is determined through the expression for the noise band for a linear pulsed phase-locked loop model. If samples of the input noise are independent, narrowing of the hold band caused by a change of frequency of the pulsed element does not lead to a decrease of the dispersion of the phase error. A formula is given for calculating the correlation of input noise during determination of the dispersion of the phase error in cases when the noise bands are known. References 8: 7 Russian, 1 Western.
[69-7872]

UDC 621.315.2.01

TRENDS IN DEVELOPMENT OF CABLES FOR DIGITAL TRANSMISSION SYSTEMS (SURVEY)

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 9-13 manuscript received 12 Oct 78

RUGA, A. D. and CHERNYSHEVA, T. M.

[Abstract] In communication systems based on digital data transmission, 1-cable low-frequency and 2-cable high-frequency systems, utilization of cable pairs depends largely on the shielding and, moreover, symmetric cables are preferred to coaxial ones primarily for economic reasons. The principal developments discussed here are various shield constructions and resulting performance characteristic (frequency dependence of the mean crosstalk attenuation): S (or Z), C, and D shields found in Western countries (USA, Canada, France, Japan) and Z shields with 100% pair utilization found in the Soviet Union. In all of them porous polyethylene insulation has already partially or completely replaced solid insulation. The feasibility of manufacturing symmetric cables with group shielding of copper strands 1.2 mm in diameter for digital data transmission at frequencies up to 35 MHz is being studied in the Soviet Union, as a more economical alternative to coaxial cables in interurban and zone communication systems. Figures 7; tables 1; references 10: 2 Russian, 8 Western.
[54-2415]

MORE EFFICIENT UTILIZATION OF ZONAL SINGLE-QUAD CABLES

Moscow VESTNIK SVYAZI in Russian No 10, Oct 80 pp 28-29

GRIGOR'YEV, V. A., senior engineer, Station Tuneup Laboratory, All-Union State Trust for Construction of Long-Distance Wire Communication Structures

[Abstract] Symmetric single-quad cables with K-60 multiplexing transmission systems are now used in zonal telephone networks. The operating frequency band of such a system is 12-252 kHz, while unattended repeater stations can compensate the attenuation over 9-11 km long line segments at frequencies up to 620 kHz. This has made possible transmission at 12-252 kHz over one pair and at 312-552 kHz over the other pair in cable trunks with a low shielding factor, and thus made feasible operation of two K-60 systems with a total of 120 tone-frequency channels. Now under consideration is a 375 km long line of symmetric single-quad cable carrying 240 tone-frequency channels with spectrum inversion in one of the transmission systems for adequate shielding. Here a better method of achieving this is proposed, namely installing two line channels for frequencies up to 552 kHz and countermeasure elements in repeater stations. Proper combinations of RC, GC, or RLC corrective circuits are found to increase the shielding factor in line segments between attended repeater stations from the minimum necessary 55 dB to more than 65 dB. The same scheme applies in principle to unattended repeater stations, for which a special countermeasure breadboard has been built and tested. Figures 2.

[95-2415]

UDC 621.395.51:621.315(001.2)

ANALYSIS OF COMMUNICATION CABLE VULNERABILITY TO LIGHTNING DISCHARGES

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 1-5 manuscript received 15 Aug 79

KIRICHENKO, V. P. and RAZUMOV, L. D.

[Abstract] Damage to communication cables caused by lightning strokes during the 1974-1978 period has grossly exceeded estimates, because many factors characterizing a given geographical location and the combined effect of such factors were not considered in the planning stage. A new study was made, therefore, to determine the effect not only of the last fatal lightning stroke but also previous less debilitating strokes on various types of cable trunks. Accordingly, statistical data were collected and evaluated, cumulatively from 1970 on, which interestingly indicate no correlation between duration of storm activity in any given territory and the degree of cable damage, as well as no correlation between the number of fatal strokes on a cable and the electrical resistivity of the soil. They indicate, however, that woody and marshy terrain should be avoided, that proximity to overhead communication lines and electric power transmission lines as well as to electrified railroad lines should be avoided, and that double (aluminum-lead) shielding of communication cables

improves their immunity, especially in high-resistivity soil. The vulnerability of communication cables increases when they are routed in the direction of storm front propagation. With this and all other factors taken into account, it appears necessary to revise the existing cable laying technology and governing specifications. Figures 6; tables 9; references: 4 Russian.
[54-2415]

UDC 621.315.213.029.55:621.391.827.22

POWER OF INAUDIBLE NOISE DURING OPERATION OF MANY PARALLEL K-60 TRANSMISSION SYSTEMS

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 22-23 manuscript received 3 Oct 79

TSYM, A. Yu.

[Abstract] The total power of inaudible noise in a tone-frequency channel caused by simultaneous interference from any number of transmission systems is calculated by a method which derives from the well-known theorem about the spectral density of a random process at the output of a linear fourpole network. It takes into account the attenuation in the amplifier stage and the noise immunity of the amplifier stage. Because that noise immunity is a random quantity, so is the average power of persistent inaudible noise. Calculations by this method, with the aid of a table of unconditional probability densities covering the entire 71.2-89.4 dB range, indicate that in channels with MKB 32x2 or MKB 24x2 symmetric cables the power of inaudible noise will not exceed permissible limits amid up to 24 parallel operating and interfering K-60P transmission systems. Tables 1; references: 2 Russian.
[54-2415]

UDC 621.376.33

THE NOISE IMMUNITY OF AN AUTOCORRELATION DIGITAL DEMODULATOR OF FREQUENCY TELEGRAPHY SIGNALS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 5-9 manuscript received 21 Apr 80

TYAZHEV, A. I.

[Abstract] The literature contains no estimate of the noise immunity of a demodulator of frequency telegraphy signals which uses a shift-register delay line. This demodulator is frequently called an autocorrelation demodulator. It is the type of demodulator used to detect frequency telegraphy signals in the "Prizma" radio receiver. Equations are derived for the probability of error upon detection of

frequency telegraphy signals against a background of fluctuating noise with the use of an autocorrelation digital demodulator (ADD) and the optimal operating conditions are determined, such that the probability of error is minimal. It shows that in actual apparatus the operating conditions of the ADD are not optimal and the energy loss which this produces is determined. The equations produced for the calculation of P_{er} define the limit of the noise immunity of the ADD during detection of frequency telegraphy signals with various ratios of the two frequencies. Error probability is minimal for a special optimal telegraphy signal with $f_h/f_l=2$ if the delay of a pulse in the system is equal to the length of a pulse. The error probability in this case is equal to the error probability for autocorrelation reception of relative phase telegraphy. When the delay is half as long, the probability of error is the same as for optimal noncoherent reception of orthogonal frequency telegraphy signals. Figures 4; references: 6 Russian.
[85-6508]

UDC 621.391.278:621.376.655

STATISTICAL ESTIMATION OF THE TIME OF ARRIVAL OF A SEQUENCE OF OPTICAL PPM PULSES

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 74-76 manuscript received 21 Jun 79

GOL'DSHTEYN, Yu. A. and FREZINSKIY, B. Ya.

[Abstract] The method of "decision-based estimation" is explained. This method is the best method for estimating the shift of a pulse in a train relative to the a priori time position of the pulse. The shift x is determined on the basis of a delayed decision concerning the position of the pulses. An equation is presented which illustrates the algorithm of maximum likelihood for determination of the position of pulses with imprecise synchronization for Poisson distribution of photoelectrons. An algorithm is presented for the maximum likelihood estimate of x based on the decision made concerning the position of the pulses using the first algorithm. The algorithm produces a zero-mean estimate which is unbiased. The estimate can be improved by increasing the number of pulses or the pulse energy used to derive the estimate. The structure of the estimate equation is independent of the type of pulse sequence received, so that no special synchronizing sequence of pulses need be transmitted. References: 2 Russian.
[85-6508]

ESTIMATE OF NOISE IMMUNITY OF NONPARAMETRIC DETECTION OF AN OPTICAL SIGNAL AFTER PASSAGE THROUGH A TURBULENT ATMOSPHERE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 10-14 manuscript received 1 Feb 80

AKIMOV, P. S. and MINACHEVA, A. V.

[Abstract] Because of the variability of transmission path conditions with such factors as weather and time of day, the quality of detection of optical signals may differ significantly from design conditions. The use of nonparametric procedures allows an increase in the reliability of detection of optical signals. Nonparametric algorithms have the property of invariance of the probability of false detection with the type and distribution parameters of noise. This article studies the characteristics of a Neuman-Pierson detector operating with a train of pulse signals, utilizing the number of photoelectrons (PE) accumulated or the rank statistics of the number of such PE, assuming that multiplicative noise caused by turbulence in the atmosphere is present. The essence of the rank procedure is that the problem of detection in any given channel is solved by using the value of the ranks r_i ($i=1, n$), i.e., the number of times the reading of the number of PE in this channel exceeds the number of a noise sample i_{ij} ($j=1, m$) in m neighboring (in time, angle or frequency) independent resolution channels over n observation periods. The test statistics are based on the accumulated sum of ranks in n observations. It is assumed that the length of a train of pulses is much less than the correlation interval of atmospheric fluctuations. The degree of stability is represented by the increment in the threshold signal-to-noise ratio Δa . The increment in Δa for a rank detector with a highly turbulent atmosphere is not over 0.3 dB, whereas for a PE accumulator it is as great as 5 dB. The calculated characteristics are also used to construct a graph of the variation in losses of threshold signal-to-noise ratio of a rank detector in relationship to a PE accumulator. The rank detector has slight turbulence losses (on the order of 2.5 dB) though with moderate and severe turbulence a gain (negative loss) of up to 2 dB is observed. Because rank processing guarantees a constant probability of false detection, there is no need to increase the threshold level (decreasing probability of detection) as is required with classical processing in order to guarantee that false detection will not exceed a certain value. The slight loss in a rank detector with weak turbulence in the case of slow fluctuations can be compensated by the invariance of rank statistics, because there is no need to provide a great reserve of power, as is necessary in order to compensate for the deterioration in detection quality as the threshold increases. Figures 3; references: 6 Russian.

[85-6508]

EXPERIMENTAL STUDY OF THE CORRELATION CHARACTERISTICS OF THE NOISE FROM OTHER STATIONS IN SHORTWAVE RADIO CHANNELS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 60-63 manuscript received 10 Mar 80

SHAROV, A. N., GROSHIKOV, Ye. N. and SLABNOV, A. M.

[Abstract] Statistical studies are used to determine the probability characteristics of the estimated values of standardized correlation function of discrete sequences of radio noise levels. Typical realizations of the correlation function are approximated by analytic expressions and the parameters of the analytic expressions for these functions are estimated. The cumulative coefficients of asymmetry and excess of the empirical distribution functions of noise levels are also analyzed. The initial statistical material used for determination of the correlation function consisted of the results of measurements of levels of radio noise at various frequencies in the 1.5-20 MHz band, integrated over time intervals of 0.5 and 1.5 s. The measurements were performed in October-December of 1977 and May-July of 1978 both day and night by a special noise-level analyzer. The ionosphere was unperturbed during the experiments ($W^{\circ}20$ and $W^{\circ}50$). At least 400 samples were used in each calculation. Correlation functions approximated by an exponential-cosine law were most common (about 52% of the cases). In approximately 43% of cases the function was approximately exponential. Exponential functions are more characteristic for narrow transmission bands, exponential-cosine functions--for broader transmission bands (over 1 KHz). The average values of correlation intervals for 1200 Hz bandwidth were 0.5-3.5 minutes in the day, 0.3-2.5 minutes at night. No significant deviations were found at $\Delta F=500$ Hz or $\Delta F=3100$ Hz. The time distribution of probabilities of noise levels agrees satisfactorily with the normal distribution in most cases. Figures 2; tables 1; references: 5 Russian.
[85-6508]

PERFORMANCE AND APPLICABILITY RANGE OF A SYSTEM OF TRANSMISSION OVER A GENERAL-PURPOSE SIGNALIZATION CHANNEL

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 24-28 manuscript received 8 Dec 78

VASIL'CHENKO, A. I., ZHARKOV, M. A., LUTOV, M. F. and YUNAKOV, P. A.

[Abstract] A new international system of transmission over a general-purpose signalization channel is being developed for use in various segments of a national network with time and frequency division of channels. This is system No 7, featuring a high error immunity (probability of undetected errors in a message not exceeding 10^{-10} at an error factor not larger than 10^{-4}) with a polynomial of the 16th degree generating cyclic codes. Messages of variable length from 56 to 560 bits will be transmitted at various rates, protection against errors being ensured by means of a NACK reinterrogation signal according to the ITCC procedure. Here the performance of this system is evaluated in terms of the probability of message delay. Calculations are based on a supplementary time distribution function for the sum of two mutually independent random quantities, waiting time and transmission time, its Laplace-Stieltjes transform and asymptotic approximations of both components. A comparison of the results with those based on load models in various communication networks (Italian, Belgian, French) reveals a close agreement when the maximum allowable delay time is $t > 20$ ms. Therefore, the applicability of this system can be predicted analytically without laborious simulation. Accordingly, the system can be recommended for transmission not only at the high rate of 64,000 bits/s but also at the low rates of 4800 or 2400 bits/s. In the latter case it is necessary to include prioritization service. The system is usable for local and interurban telephone networks in the Soviet Union. Figures 4; tables 1; references 14: 5 Russian, 9 Western (1 in translation).

[54-2415]

UMG-2 EQUIPMENT FOR TRANSMISSION OF SERVICE MESSAGES IN AUTOMATIC INTERURBAN TELEPHONE EXCHANGES

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 29-33 manuscript received 5 Feb 79

DOBROVOL'SKIY, V. V., KUSHMANOV, I. V. and FILATOV, A. M.

[Abstract] The "mechanical voice" device UMG-2 has been developed at the Moscow Institute of Electrical Engineering of Communications for transmitting service information over interurban telephone channels during various stages of connection between subscribers. It has six channels for simultaneous transmission, recording and playback of six 6 s long messages with provisions for their individual erasure. It

consists of two principal message transmitters, an automatic switch for transfer to a standby transmitter in case one principal transmitter fails or its output level drops to more than 13 dB below nominal, and auxiliary equipment. Each principal transmitter also includes a drum with an elastic magnetic tape, a set of magnet heads, a transport mechanism which sets the drum in motion, and a power supply. The transport mechanism operates with a synchronizing circuit which puts out current pulses of 50-100 ms duration in order to indicate the beginning and the end of each message. These pulses trigger, through relays, the station equipment in order to ensure that the UMG-2 device is respectively connected to and disconnected from the subscriber line. Two "light source - photoreceiver" pairs are used as pulse transmitters, each synchronizing circuit including two transistors, a light-activated diode, and a photoresistor. Playback is effected through an amplifier, with an integrated-circuit preamplifier for maintaining the necessary signal-to-interference ratio and correcting any distortions of the amplitude-frequency characteristic. The device operates from an a.c. line which draws not more than 100 VA. Figures 6; tables 1; references: 3 Russian.
[54-2415]

UDC 621.395.374:681.3

OPERATIONAL PERFORMANCE ANALYSIS OF AUTOMATIC INTERURBAN TELEPHONE EXCHANGES

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 33-37 manuscript received 27 Sep 78

SILKIN, A. A., FRUNZE, G. A., KIRTOK, O. V., POLONSKIY, Ye. P. and FUKS, A. L.

[Abstract] An automatic interurban telephone exchange can be treated as a queuing system where failures are subject to certain statistical laws of probability. Such an exchange is the AMTC-1 which consists of four major segments: 1) GChD (general checking device) - RLAC (relay for lines of automatic connection); 2) RLAC-OCRC (outgoing code register for cord relay); 3) OCRC - D (decoder); and 4) OCRC - IGS (interurban group selector) - OTDS (outgoing tone dialing set). Here the operational adequacy of this system is analyzed in terms of the loss factor for each segment. Accordingly, each segment individually, as well as the relay and the decoder, are regarded as operational when, upon checking, the specific weight of test messages lost in it during a sufficiently long time is found not to exceed, by statistical probability, the permissible loss factor. This method of checking the operational adequacy has been introduced in the Moldavian Telephone Network (Kishinev), with all the necessary equipment including a computer for data processing. Figures 3; references: 5 Russian.
[54-2415]

IMPROVING THE RELIABILITY OF EQUIPMENT IN AUTOMATIC ZONAL TELEPHONE EXCHANGES

Moscow VESTNIK SVYAZI in Russian No 10, Oct 80 pp 26-28

NEVEYKIN, V. I., senior engineer, Industrial Laboratory, Leningrad Industrial-Engineering Communications Administration (PTUS), and YATSENKO, V. I., senior engineer

[Abstract] While an automatic interurban telephone exchange was installed in the city of Leningrad, it was also found possible to improve the existing automatic zonal telephone exchange (AZTS). These improvements included corrections and adjustments in relay circuit boards RSLT-I, RSLT-VM, VV (line connecting relays), RTU (remote-control relay) and the P2600 panel. Modifications such as a more economical timing of relay operations along with better control and protection of electronic switching elements, achieved by appropriate replacement or addition of resistors and capacitors with necessary changes in the physical layout, have made the performance of this exchange much more reliable since 1978. Further improvements are needed for making its operation more economical, for which statistical data on channel utilization and means of including these data in the overall system analysis will prove to be helpful. Figures 8.

[95-2415]

UDC 621.395.422:750.672.48

IMPROVING THE QUALITY AND THE RELIABILITY OF SYSTEM K-1920 TRANSMISSION CHANNELS

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 14-15 manuscript received 10 Jan 80

ZUBRITSKAYA, A. F. and POPOVA, N. E.

[Abstract] Maintaining high service quality and reliability of a communication system requires, according to present specifications, regular inspection of group and line channels which involves measurement of the overall attenuation and the noise level as the two basic indicators of defects in the equipment. Such an inspection should be broadened, however, to include also short and long interruptions, pulse interference, and changes in load power as well as in signal frequency. All the material necessary for this purpose had been documented and prepared for automatic testing of the K-1920 transmission system in service. The results of this study revealed inadequate dynamic and amplitude-frequency characteristics of the 4-frequency automatic gain control in line channels, a low reliability of high-frequency components in attended and unattended control stations and of terminal equipment, a low quality of group channel separating equipment, also degradation of performance after routine tests and adjustments made following incorrect procedures. All these deficiencies were subsequently eliminated so that by 1978 the quality and the reliability of K-1920 channels could be restored to specifications and the service much improved.

[54-2415]

MODERNIZATION OF THE MODEL 'DOZHD'-2' UHF FM TRANSMITTER SET

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 38-41 manuscript received 12 Feb 80

GOLOMBEK, I. I., KALININ, L. B. and SOLOV'YEV, V. E.

[Abstract] The largest stereophonic broadcasting radio transmitter set in the Soviet Union is the "Dozhd'[Rain]-2" UHF FM model, already installed in more than 350 stations and still in production for further demand. Its design has been recently modernized in order to meet the more stringent requirements of broadcasting in either "stereo" or "mono." Accordingly, one of the two 4 kW transmitters has been modified. The frequency triplers and the exciters have been eliminated from the high-frequency channel, a voltage halver bridge with matching transformers replaces automatic phasing, wideband exciters and stereophonic modulators with automatic standby have been added for hookup to existing station equipment, and the exciter switching relay has been replaced with an REV-15 radioelectronic relay for remote switching from "stereo" to "mono" or vice versa. The new equipment was tested under service conditions and no failure found to occur after 4000 h of operation. Figures 5; tables 1; references: 2 Russian.
[54-2415]

MAXIMUM SIGNAL-TO-NOISE RATIO IN RECEPTION OF PULSE-TIME-MODULATION SIGNALS

Moscow ELEKTROSVYAZ' in Russian No 10, Oct 80 pp 55-57 manuscript received 14 Mar 79

PALSHKOV, V. V.

[Abstract] Transmission of pulse-time-modulated analog signals over microwave and optical communication lines offers the advantages of simple modulator equipment. Here the performance of such a transmission system is evaluated in terms of the maximum signal-to-noise ratio attainable at the receiver output. A receiver consists of an antenna, a high-frequency channel including a quasi-optimal linear filter with an almost rectangular amplitude-frequency characteristic, a pulse detector, a threshold device and a PTM detector. Both the signal output voltage and the noise output voltage are calculated on the basis of general relations, then the signal-to-noise ratio as a function of the relative receiver bandwidth (the optimum receiver bandwidth being equal to the transmitter bandwidth). In a microwave system the maximum signal-to-noise ratio depends on the noise factor of the receiver and on the signal parameters. In an optical system with optoelectric conversion the maximum output signal-to-noise ratio depends on the signal level (current amplitude) only, it is attainable and ceases to depend on the noise factor when the latter remains very low. Figures 2; references: 6 Russian.
[54-2415]

A MODEL OF AMPLITUDE-PROBABILITY DISTRIBUTION OF SMOOTH PULSE-MODULATED RADIO NOISE

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 10, Oct 80 pp 48-51

BLOKHIN, Yu. V., ZHURAVLEV, E. N., STROCHKOV, P. A. and YAROSLAVSKIY, V. N.

[Abstract] One type of radio interference is smooth, pulse-modulated noise, sources of which include electric power transmission lines, program-controlled electric motors, fluorescent lamps and computers. Radio interference of this type is recorded at the output of the IF amplifier of radio interference meters near AC power transmission lines. A study is made of a statistical model of the amplitude-probability distribution of radio noise and the relationship between the indications of various types of detectors for this case. Quasi-peak, mean, mean square and peak detectors are discussed. The parameters M (voltage with quasi-peak detector divided by voltage with mean square detector) and L (voltage with quasi-peak detector divided by voltage with mean detector) are calculated, and the variation in M and L as functions of parameters of the process have a typical bell shape, a result of the fact that the indications of the quasi-peak detector at small T/τ are practically independent of low-level background, whereas the detectors of mean and mean-square values consider the presence of this background at all ratios of T/τ . The inverse problem is also analyzed, and a table presents the values of average and mean-square levels of noise obtained experimentally and by calculation using various models. It is seen that the maximum divergence between experimental and calculated values is 2.7 dB for average values and 3.4 dB for mean-square values. This accuracy is quite acceptable, because the amplitude-probability distribution was measured using a counter with threshold levels at intervals of 6 dB and V_{av} and $V_{m.sq}$ were measured by instruments with errors of ± 2 dB. The relationships found between the parameters of the amplitude-probability distribution model and the indications of various types of detectors for smooth pulse-modulated radio interference will allow previously accumulated experimental material to be utilized. Figures 3; references 10: 4 Russian, 6 Western.

[84-6508]

COMPONENTS AND CIRCUIT ELEMENTS, WAVEGUIDES,
CAVITY RESONATORS AND FILTERS

UDC 621.311.6:621.396.96

PERFORMANCE FEATURES OF RECTIFIERS WORKING ON NONLINEAR LOADS--MICROWAVE DEVICES,
TRIODES AND TRANSISTORS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 84-85 manuscript
received 21 May 79

NOVIKOV, V. F.

[Abstract] A nonlinear load on a rectifier can be characterized by a dynamic resistance at the operating point, usually either much lower or much higher than the static equivalent resistance. Here a rectifier with a smoothing Γ -filter supplying a microwave device is considered, and the behavior of individual harmonics in the ripple spectrum is analyzed as the load changes from its static to dynamic level. The modulus of the transfer function is calculated for the two extreme resistance values, whereupon the ratio of the two moduli and the output voltage in each case have been plotted as functions of the frequency. The differences are found to be largest near the series resonance. An experiment was performed using a continuous-wave magnetron with a static resistance of 9.4 kohm and a dynamic resistance of 0.44 kohm. The results indicate that in this case the ripple components decrease under the load. In the case of a microwave device with a dynamic resistance higher than the static resistance (O-type, triodes, transistors) the ripple components will increase under the load. Figures 2; references: 3 Russian.
[93-2415]

INVESTIGATION OF COMPLEX WAVES OF TWO-LAYER SHIELDED WAVE GUIDE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 59-62 manuscript received 23 Jan 80

VESELOV, G. I., RAYEVSKIY, S. B. and KALMYK, V. A.

[Abstract] In view of the existence in an open-ended circular two-layer shielded wave guide of a standing wave field, localized near a point source in the center of the wave guide, in which the complex resonance is distinguished by a nearly constant Q-factor in the entire complex wavelength range, the phase constants and attenuation coefficients of the complex waves are determined, an experimental estimation is given, the Q-factor of complex resonance is calculated and the excitation of complex waves is examined on the basis of repeated measurements of the longitudinal field distribution in special resonance structures. The longitudinal cross section of the wave guide structure is illustrated and the design of the wave guide and driver is described. The longitudinal field distribution is measured on different fixed frequencies in order to determine the phase constant and attenuation coefficient. The design of the resonator utilized in the study is described and the field distribution in the resonator is determined for two types of resonance. The nature of the longitudinal field distribution is illustrated. The field level and Q-factors are determined for both types of resonance. The field sources in the experiment were placed in the plane of the cross section of the wave guide and a pair of waves, forward and backward complex waves, were simultaneously excited, producing a standing wave field. A specific resonance is observed both in closed and in end-matched two-layer wave guide segments. The Q-factor of complex resonance in the examined wave guide structures is 300-1,000 and decreases toward the bottom frequency of the complex wavelength range. Wavelength does not depend on the longitudinal coordinate, which means that the investigated waves are complex. Figures 4; references 7: 6 Russian, 1 Western.
[69-7872]

CONFERENCES, SEMINARS, EXHIBITIONS, SYMPOSIUMS

FOR SIGNALERS OF KARELIA AND NORTHERN REGIONS

Moscow ELEKTROSVYAZ' in Russian No 9, 1980 p 64

SVERDLOV, I. S.

[Abstract] An All-Union Scientific-Research Seminar on the development of multi-channel and automatic electrical communication was held at Petrozavodsk on 6-8 May 1980. The Karel'skaya ASSR became the 12th region where a seminar has been held as the result of a 1967 initiative of the Central and Moscow City boards of the Scientific-Technical Society of Radio Engineering, Electronics and Communication imeni A. S. Popov (NTORES). [See ELEKTROSVYAZ', No 12, 1979]. The 1980 seminar was organized by the Central and Karelian oblast boards of NTORES, the USSR Ministry of Communications, and the Ministry of the Communications Equipment Industry. In great measure the successful and efficient course of the seminar was determined by the great preparatory work of the managers of the Karelian Industrial-Technical Administration of Communications (PTUS) and TTsUMS-23 [expansion unknown], and by the participation in the seminar and the attention paid to it by party, soviet and trade union organs of the republic. One hundred forty electrical communications specialists of Karelia and 15 northern oblasts of the European part of the RSPSR--managers, chief engineers, engineers of various services of PTUS and of communication enterprises of different services--listened to 25 reports given by leading specialists of the field who came from Moscow, Leningrad, and other cities. Brief comments are made about the papers read.

[72-6415]

CONVERTERS, INVERTERS, TRANSDUCERS

UDC 621.372.54.01

MATCHING OF AN EIGHT-BAND FREQUENCY-DIVISION DEVICE

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 40-42 manuscript received 5 Oct 79

BRUK, Yu. M.

[Abstract] It is thought that eight-band frequency-division devices (FDD) consisting of hybrid adders and dual filters are complex, have excessive losses and that their actual characteristics are quite dissimilar to their calculated characteristics. A new FDD of this type is studied in order to demonstrate that these opinions are incorrect. The FDD in question utilizes identical filters and a matching circuit between the hybrid adder and the filters. All of this allows the potential possibilities of the FDD, including formation of any AFC over a broad band of frequencies and the achievement of matching and thus decoupling of all inputs, to be achieved with a significant simplification of the hardware. Two limiting cases of frequency range are experimentally investigated, and it is determined that the frequency range is limited only by the transmission band of the hybrid adder, 0.5-1,000 MHz, indicating that these FDD can be used to construct multiplexers and antenna amplifiers for this entire frequency band. The author thanks V. Yu. Yermakov for conducting the experiment. Figures 3; references 10: 6 Russian, 4 Western.
[85-6508]

UDC 621.382.2.029.64

EXPERIMENTAL STUDY OF FREQUENCY CONVERTERS BASED ON ELECTRON-TRANSFER DIODES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 80-81 manuscript received 8 Oct 79

ROMAN, O. A. and TREPAKOV, V. K.

[Abstract] An experimental study was made of an autodyne frequency converter on an electron-transfer diode with input power levels approximately the same as the output power of such devices operating as oscillators. The diode was mounted between the wide walls of a coaxial waveguide resonator, with two phase shifters for tuning. The equipment also included a source decoupling low-pass filter and a load-matching

transformer. The amplitude characteristics of conversion from a 500 MHz source frequency to the upper intermediate frequency of 10,900 MHz and to the lower intermediate frequency of 9950 MHz were measured in terms of the conversion ratio and the output power, respectively, as functions of the input power. Figures 3; references 4: 3 Russian, 1 Western.
[93-2415]

ELECTROACOUSTICS

UDC 537.226:537.311.322

ACOUSTOELECTRIC EFFECT IN A METALLIZED PIEZOELECTRIC WAVEGUIDE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 73-75 manuscript received 21 Apr 80

OSTROVSKIY, I. V.

[Abstract] The acoustoelectric effect in piezoelectric semiconductors is analyzed in the case of metallized rather than free surfaces of the piezoelectric plate in a microwave device. The problem of a transverse elastic wave propagating along one crystallographic axis is solved through the standard equations of motion and electrodynamics, with zero elastic stress and zero tangential electric field intensity assumed at both base surfaces. Expressions are thus derived for the local currents and for the damping coefficient in symmetric and antisymmetric modes. Figures 1; references 4: 3 Russian, 1 Western.
[93-2415]

TOWARD A THEORY OF OPTICAL WAVEGUIDE MODES IN A BAND DOMAIN STRUCTURE

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 3, 1980 pp 473-476 manuscript received 28 Jul 79

SEMENTSOV, D. I.

[Abstract] A theoretical study is made for the first time of the possibility of the waveguide propagation of electromagnetic radiation in a band domain structure in a magneto-optical crystal. In structures of this sort the interface between domains or two magnetic films whose magnetization differs in magnitude and direction represents an optical inhomogeneity formed by gyration terms of the tensor of the dielectric constant and possessing waveguide properties. The goal of the study is to investigate the possibility of creating on the basis of these structures magnetically controlled space modulation, multichannel branching and other processes for controlling laser emission. On the basis of an equation for the tensor of the dielectric constant and for the field components of the waves propagated along the domains, a dispersion relation is derived which defines the optical waveguide modes in a band domain structure. It is demonstrated that the number of waveguide modes at an assigned frequency is finite and depends on the parameters of the band domain structure, which can be controlled by means of an external magnetic field. It is possible to reduce the period of the structure without changing its symmetry by applying a magnetic field in the plane of the wafer along the band domain, but then the separation of waves propagated in the domain band structure into TE and TM modes becomes impossible because a magnetization component parallel to the field originates in the domains. An analysis is made of the dispersion relation for an asymmetric domain structure. This structure is realized in magnetic fields perpendicular to the surface of the wafer. By varying the perpendicular magnetic field it is possible to alter the symmetry of the band domain structure so that the difference between the width of two domains changes from zero to the value of the period of the structure. It is demonstrated that for the case of an asymmetric domain structure for random values of the ratio of the difference in the widths of two domains and the period of the structure doubling of the number of waveguide modes takes place as compared with a symmetric band domain structure. Figures 2; references 7: 5 Russian, 2 Western.

[35-8831]

ANALYSIS OF NEAR ELECTROMAGNETIC FIELD IN RADIATOR APERTURE FOR DIFFERENT FIELD PHASE DISTRIBUTIONS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 75-76 manuscript received 13 Dec 79

DRABKIN, A. L., SHONIN, O. B. and SHKLYAR, I. V.

[Abstract] The results are presented of the solution of the special problem of determining the influence of different field phase distributions in the aperture of a radiator on its near field pattern. The optimum phase distribution is determined such that the near field radiation pattern is as close as possible to the one desired. The experiment is presented for the purpose of developing aperture radiators, intended for transmitting microwave energy into frozen rock for the purpose of reducing its mechanical strength so that it can be broken up. The design of the radiator is described and illustrated. Curves of equal electric field energy densities at certain points in space are plotted for different field phase shifts on elementary surfaces of the radiator aperture. The near field structure can be analyzed by determining the temperature field produced by absorption of electromagnetic energy in a medium with losses, which is proportional to the square of the modulus of the electric field intensity and electrical conductivity of the medium. In order to test the calculations, a specimen of frozen sand was irradiated from the open end of a waveguide with a controlled field phase distribution. Figures 2; references: 2 Russian.

[69-7872]

UDC 621.385.5

PASSAGE OF A SIGNAL THROUGH A TRAVELING-WAVE TUBE AND A COMPRESSION FILTER

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 64-68 manuscript received 19 Jun 79, after revision 2 Aug 79

ISHCHENKO, A. I.

[Abstract] A signal passing through a radio transmitter with a traveling-wave tube leaves the tube distorted, this distortion depending on the frequency characteristics of the tube and on the changes in its parameters during the pulse time. Here the effect of this distortion on the matching to a compression filter behind the traveling-wave tube is analyzed, assuming this filter to have been matched to the signal at the tube input. General calculations are based on the linear theory of the transfer function of a traveling-wave tube. Specific calculations are made for an input signal in the form of a rectangular pulse with linear frequency modulation. Typical results are shown for a traveling-wave tube with constant parameters and for one with parameters varying linearly in time. Figures 2; references: 5 Russian. [93-2415]

UDC 621.385.6.001.24

PERFORMANCE CALCULATIONS FOR O-TYPE DEVICES WITH COUPLED NONIDENTICAL RESONATOR CIRCUITS OPERATING IN THE LINEAR MODE

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 43-48 manuscript received 19 Dec 79

DENISOV, A. I., PEREKUPKO, V. A. and RAPOPORT, G. N.

[Abstract] Designing the output segments of multisegmental O-type amplifiers with coupled nonidentical resonator circuits requires application of nonlinear theory, while the input segments can be designed on the basis of linear theory. The dispersion equation is not very helpful for calculating the performance characteristics and, therefore, an algorithm is proposed here which yields self-consistent results. This algorithm involves standard procedures for matrix multiplication, using the inverse transfer matrix of an octupole network, and has eliminated the need for solving fourth-degree equations with complex coefficients. As an illustration, the

longitudinal gain distribution in a device consisting of 6 identical resonators in one segment and 2 groups of different 6 identical resonators in the second segment has been calculated accordingly, as well as the frequency dependence of current amplification near the long-wave edge of the transmission band of a device consisting of 36 inductively coupled resonators with excitation by a density-modulated electron beam. Here with increasing voltage, the maximum gain is also found to increase and to shift toward lower frequencies. The third example is a 3-segment device with shifting of the long-wave edge for the purpose of widening its transmission band. Figures 4; references 6: 4 Russian, 2 Western.
[93-2415]

UDC 621.385.632

FREQUENCY CHARACTERISTICS OF INTERMODULATION OSCILLATIONS IN AN O-TYPE TRAVELING-WAVE TUBE DURING 2-SIGNAL OR 3-SIGNAL AMPLIFICATION

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 68-70 manuscript received 12 Dec 79

ALGAZINOV, E. K. and MYMRIKOVA, N. N.

[Abstract] Intermodulation components in the output spectrum of a traveling-wave tube used as the input amplifier in a radio receiver appear when the input signal is weak and, if any of them falls within the receiver pass band, will interfere with the useful output signal. Here the frequency selectivity with respect to second-, third-, and even fifth-order intermodulation within a frequency range of at least one octave is analyzed in the case of two interfering signals at the input of an O-type traveling-wave tube. The largest components in the spectrum of combination frequencies are those with the frequencies $2\omega_1 - \omega_2$ and $2\omega_2 - \omega_1$, but a large sum-frequency components can also appear and, accordingly, also the case of three input signals is considered here. Figures 3; references: 4 Russian.
[93-2415]

POSSIBILITY OF REDUCING THE NONLINEAR DISTORTION OF A SIGNAL IN A WIDEBAND TRAVELING-WAVE TUBE BY MEANS OF A PHASE JUMP OF THE SECOND FIELD HARMONIC

Kiev IZV. VUZ: RADIOELEKTRONIKA In Russian Vol 23, No 10, Oct 80 pp 70-73 manuscript received 14 Jan 80

SIVYAKOV, B. K.

[Abstract] A harmonic signal amplified in a wideband traveling-wave tube with a helical low-dispersion retarding system becomes distorted as a result of interaction between the second harmonic of the convection current in the electron beam and the second harmonic of the microwave field, both second harmonics being in synchronism. A phase jump of the second field harmonic, with an attendant increase in the dispersion of the retarding system, seems in theory effectively to reduce the nonlinear distortion of the signal. Efficiency calculations indicate, moreover, that this method is preferable to jumping the phase of the main signal and to using special drift or absorber segments in the line with a resulting much longer signal saturation zone. Figures 4; references 7: 4 Russian, 3 Western.
[93-2415]

ENERGY SOURCES

UDC 623.383

DIELECTRIC-SEMICONDUCTOR STRUCTURES WITH SCHOTTKY CONTACTS FOR PHOTOELECTRIC CONVERSION

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 456-463 manuscript received 28 Sep 79

GIL'MAN, B. I., KASATKIN, V. V., SURZHIK, T. M. and TRET'YAKOV, A. P.

[Abstract] One major type of surface barrier structure being studied at the present time for the conversion of light energy into electrical is a metal-semiconductor (Schottky barrier) structure with a tunnel dielectric interlayer (an MTDP), which acts as the current collecting region of the photodetector. The photocurrent passing through the tunnel dielectric is collected by the entire metalized surface. Problems in fabricating MTDP photodetectors are related in particular to the formation of a high-conductivity transparent metal barrier layer with a large area, and to a complex system of optical coatings. Another major type of structure is a dielectric-semiconductor surface barrier structure with an induced inversion channel. This type of photodetector contains local metalized diffusion regions which perform the functions of current collectors. It has been suggested that photodetectors be created on the basis of a combination of DP (dielectric-semiconductor) and MTDP surface sections, which for one thing makes it possible to use inexpensive polycrystalline silicon as the base material. One problem, among many, in creating photodetectors with a DP-MTDP structure is that of forming a high-conductivity inversion channel in the DP system with the required optical properties of the dielectric. Here a discussion is presented of the physical factors restricting the possibility of inducing high-conductivity inversion layers in silicon and the results are given of the experimental fabrication of Si-SiO₂ structures with a built-in inversion channel. Experimental volt-ampere characteristics are presented for Schottky contacts of the Al, Mg - p-Si <111> type with a thermally grown SiO₂ interlayer. These characteristics confirm the existence of intense inversion in silicon and the high quality of an MTDP junction with an optimal oxidation time. It is demonstrated that in Schottky contacts based on p-Si with an SiO₂ tunnel interlayer an inversion layer can exist over a wide range of thicknesses of the tunnel dielectric and of surface state densities. Al-Mg-SiO₂ (tunnel dielectric) - p-Si structures in which the SiO₂ tunnel layer is produced by thermal oxidation in a stream of argon at 820° C for 10 to 15 s display close to ideal volt-ampere characteristics consistent with a Schottky barrier height of about 0.93 V and an inverse current of approximately $2 \cdot 10^{-10}$ A/cm². Figures 7; references 26: 8 Russian, 18 Western.

[35-8831]

INSTRUMENTS, MEASURING DEVICES AND TESTERS,
METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

UDC 389.14:621.37/.39

THE STATUS OF METROLOGIC SUPPORT OF EQUIPMENT FOR MEASUREMENT OF AMPLITUDE-MODULATED
RADIO SIGNALS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 10, Oct 80 pp 51-52

BELIKOV, V. A.

[Abstract] Recently, the equipment used to measure the parameters of AM radio signals has greatly improved. The main distinctions of the new devices include increased accuracy and expanded limits of measurement of the amplitude modulation coefficient, standardization of the AM signal envelope harmonic coefficient and partial automation of the process of measurement. Instruments currently produced include the S2-23 modulation coefficient meter, and types SK3-39, SK3-40, SK3-41 and SK3-43 combined AM-FM meters. A well-developed system of state standards supports measurement of coefficients between 1 and 100% in the frequency range from 0.1 to 1200 MHz with modulating frequencies of 0.03 to 500 KHz. The primary state standards are embodied in some 40 class I meters such as the OM-69M and K2-34 devices. The former reproduces AM signals calibrated as to AM coefficient at 5 fixed frequencies between 0.15 and 25 MHz with modulating frequencies of 30 to 15,000 Hz; the latter device uses a characteristic shape on a CRT screen to establish a reference AM coefficient of 100%, then, by precise division of the modulated voltage, obtains intermediate values of AM coefficient between 0 and 100%. Production of the standard K2-34 instrument on a series basis in the near future will greatly increase the number of standard instruments available in the country. The next level, class II, is supported by SK2-... (about 50 such instruments are operated by the metrologic service), which operates similarly to the K2-34 instrument transmitting AMC in the 0.3-100% range at one carrier frequency (10 MHz) with modulation frequencies of 0.03-500 KHz. The second group of such instruments is the MKH-6, S2-23 and S2-10 instruments, as well as the combined AM-FM instruments such as the SK3-39, SK3-40 and SK3-41 devices, used to transmit units of AM coefficient to generators of not over class V accuracy. References: 2 Russian.
[84-6508]

STATISTICAL ANALYSIS OF TYPICAL MEASUREMENT STRUCTURES OF DIFFERENTIAL REFRACTOMETERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 10, Oct 80 pp 65-67

KHURSHUDYAN, S. A., KORABLEV, I. V., KULAKOV, M. V. and KARABEGOV, M. A.

[Abstract] Mathematical models are studied of typical structures of refractometers and, based on the mathematical modeling, equations are produced for the statistical criteria of quality of typical measurement circuits, related to systematic and random errors. These criteria can be used for comparative analysis of typical structures and determination of effective conditions for their use. A distinction is made between differential refractometers with differential and compensation measurement circuits. The operation of a differential refractometer is briefly described. A table presents the nominal transformation functions of differential and compensation structures of differential refractometers, as well as expressions for the nominal sensitivities obtained from equations derived in this article. Expressions are presented for the absolute error of the refractometers. The absolute errors calculated are the sums of individual components, each of which has a specific physical sense. The first component defines the additive component of error, the second, which changes in proportion to Δn , represents the multiplicative error of sensitivity, while the third represents the error due to changes in noninformative parameters of the fluid being measured and the fourth represents the additive noise error. The equations produced are applicable for standardization of metrologic characteristics of refractometers, structural analysis, parametric optimization and estimates of threshold characteristics. The relative stabilities of the two types of refractometers are discussed: where $\lambda \gg 8$, the stability of the characteristics of the compensation refractometer is significantly greater than that of the differential refractometer. Figures 2; tables 1; references 8: 7 Russian, 1 Western.

[84-6508]

A MEASURING-COMPUTING COMPLEX FOR TESTING OF SPECTRORADIOMETERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 80 pp 25-27

GRIDIN, A. S., DAVYDOV, V. S., ZAKHARNEV, A. P., IVANOV, P. P., MURAV'YEVA, G. I. and CHUKNIN, A. Ya.

[Abstract] A measuring-computing complex is described which the authors built for testing of radiometers and which has successfully been used for 2 years. It can measure the overall transfer characteristic of optoelectronic devices and such noise characteristics as the autocorrelation function, frequency distribution function and spectral power density of the intrinsic noise. It can also extract the high-frequency

part of the transfer characteristic from background noise and measure the transfer characteristic of a receiver as well as the amplitude-frequency characteristic of an electronic channel. The complex consists of an illuminator with a power supply, a reference-signal generator, a collimator teleobjective, an oscillograph, an analog-to-PAM (pulse amplitude modulation) converter, a digital transmitter, a frequency meter, a clock-pulse generator, a synchronizing system, a multichannel amplitude analyzer, a recording instrument, and a Nairi-K computer with data input and graph plotting. The maximum angle of the field of vision is 6° , the range of space frequencies is 0-360 units/deg, the range of time frequencies is 0-5 kHz for measurement of amplitude-frequency characteristics and 0-10 kHz for measurement of spectral noise characteristics, the maximum scanning speed is 2000 deg/s, the nominal range of input signal levels is 0-10 V, and the maximum speed of data input to the computer is 2000 numbers/s with the maximum number of digits in a number being 16. Figures 2; references: 5 Russian.
[98-2415]

UDC 531.647. 08:53. 188.24

ESTIMATION OF THE INTERFERENCE IN ELECTRONIC APPARATUS CAUSED BY THE APPLICATION OF DYNAMIC LOADS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 10, Oct 80 pp 37-38

MASHARA, G. G. and SEMENOV, A. S.

[Abstract] Noise in measurement equipment exposed to dynamic physical loads arises due to inertial and force effects transmitted to the sensing elements from the load-bearing structures, deformed by vibration, impact and acoustical loading. These noise effects are particularly troublesome in apparatus designed to measure vibrations, because the noise is synchronous with the effects being measured. Deformations resulting from physical loadings also change the capacitance and inductance of components, induce piezoelectric effects and cause tensoresistive and tensocapacitive effects in semiconductor devices. The resulting noise at the output of measurement channels is determined by the internal impedance of the noise source and the parameters of the signal circuit. A figure is presented showing the primary sources of noise schematically, and the levels of vibration noise in typical circuits are graphed. Equivalent circuits and calculation equations are presented for determination of the noise emf in miniature ceramic condensers and composition resistors. The reader is referred to handbooks for the quantitative values of physical constants to be used in estimating the levels of noise when typical structural elements are exposed to dynamic loads. The maximum noise level in such a circuit is estimated, assuming a relative deformation of 10^{-3} and no failure of the elements. It is found that the noise introduced by a ceramic condenser under stated conditions is 75 mV where $j\omega RC \gg 1$. The noise from deformation of a resistor with a tensosensitivity coefficient of 2 under the same conditions is 20 mV. Measures suggested to minimize

dynamic noise are: minimization of relative displacement and deformation of electronic elements, load-bearing structures and connections; the use of elements and materials with minimum sensitivity to deformation and tendency toward electrification; and the use of circuits with low bias voltages in the input stages of apparatus. Figures 3; references: 2 Russian.
[84-6508]

UDC 535.316

DETERMINING THE ANGULAR REFLECTION FUNCTION OF A LIGHT REVERSING PRISM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 80 pp 19-20
manuscript received 25 Jul 79

SMIRNOV, L. A.

[Abstract] Both the reflection coefficient of a light reversing prism used for geodetic measurements and the divergence of the return beam vary with the incidence angle, which determines the performance of such devices. Both were plotted in the far field with a DP-876 instrument as functions of the incidence angle. The instrument consisted of a telescopic autocollimator for shaping the control beam from a laser and for constructing the pattern of reflected images, and an electromechanical photoelectron scanning system. The incidence angle was varied by rotating the prism relative to the fixed direction of the light beam and thus varying its aperture. The angular width of the reflection pattern was found to vary in one direction only, becoming as much as 5 times larger at an incidence angle of 50° , while remaining constant in the perpendicular direction. On this basis it was then possible to estimate the fraction of energy reflected by a light reversing prism which falls on a certain restricted part of the far field image such as the center part corresponding to a zero incidence angle. According to the experimental data, the reflection function of a light reversing prism can be approximated with the relation $R = e^{-5\theta}$ (θ - incidence angle in radians) accurately within 10%. Figures 3; references: 3 Russian.
[98-2415]

MAXIMUM CAPABILITIES OF WIDE-FIELD SPECTROMETERS WITH SELECTIVE INTERFERENCE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 80 pp 4-6
manuscript received 11 Dec 79

GERSHUN, M. A. and YEGOROVA, L. V.

[Abstract] Field compensation of interference spectrometers, which consist of a light splitting prism and a diffraction grating, is effected by adding another prism such as a Kester prism or a mirror in the proper position. So far compensation along one coordinate has been achieved, with the difference between diffraction angle and incidence angle remaining fixed. Now the possibility of compensation along two coordinates or in two mutually perpendicular planes is examined on the basis of a system of three trigonometric equations describing the geometry of the optical system. There are two sets of solutions, but only one is practical: it covers the entire operating $0 \leq k \frac{\lambda}{d} \leq 2$ range (k - diffraction order, λ - wavelength, d - grating pitch) of diffraction gratings with the angle difference not exceeding 30° . Compensation can be made to occur either before or after diffraction. The performance characteristics of such a system, including the luminosity gain and the instrument function of a selective interferometer, are calculated and compared with those of a system compensating along one coordinate only. There can be found an optimum ratio of stop area to fringe area with which the product of relative resolving power by relative luminosity will be maximum. Figures 4; references 4: 2 Russian, 2 Western. [98-2415]

SPECTRAL CHARACTERISTICS OF SOME FILTERS AND FILMS ON ABSORBING AND REFLECTING SUBSTRATES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 80 pp 16-19
manuscript received 21 Aug 79

GERASIMOVA, N. G., BOGDANOV, V. G., GORBACHEVA, N. A. and METEL'NIKOV, A. A.

[Abstract] Several optical materials (LiF , CaF_2 , MgF_2 , SiC , quartz) were tested as substrates for films (SiC , Al , Pt , Au , ZrO_2) for the purpose of determining the suitability and the best combinations for reference specimens in periodic calibration of spectroanalytical instruments in the vacuum UV range of wavelengths. Measurements were made using a vacuum monochromator VM-70 (50-450 nm), a vacuum monochromator with a feedthrough gas-discharge glow source VMR-2 (50-290 nm), a spectrophotometer SF-8 (160-350 nm), three standard LOMO (Leningrad Optical-Mechanical Association) filters with uniform-density metal coating and neutral glass filters, as well as a PRK-4 mercury-quartz lamp and a set of selective filters for monitoring the scattered

light. As a result, transmission spectra (120-350 nm) and reflection spectra (60-200 nm) of various substrate-film combinations were obtained. While the transmission coefficient at any wavelength depends on the film thickness, all substrates except LiF are found to have a small effect on the transmission coefficient and to reduce it by not more than 7%. The highest degree of neutrality is obtained with SiC, Pt, Au films and very suitable for reference specimens in reflection measurements are MgF₂, SiC crystals, the latter characterized by a particularly high physicochemical stability. The authors thank S. I. SAGITOV for delivery of crystals and preparation of SiC films, and L. P. SHISHATSKAYA and I. F. SHEREMET for helping with the measurements. Figures 3; tables 1; references: 17 Russian.
[98-2415]

UDC (555.214.4:621.384.3):551.46.083

SENSITIVITY FIELDS OF SPECTRAL CHANNELS IN AN INFRARED RADIOMETER AND THE POSSIBILITY OF THEIR EQUALIZATION

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 9, Sep 80 pp 11-13
manuscript received 12 Feb 80

POVARKOV, V. I. and SAMKOV, V. M.

[Abstract] A study of an experimental high-sensitivity multispectral infrared radiometer was made, for the purpose of establishing the causes of differences between the transmission characteristics of the various channels and devising a method of minimizing these differences. All channels had a common objective lens and a common nonselective light splitter, but each its own light filter, field shutter, condensing lens, and a semiconductor-type immersion bolometer serving as the radiation receiver. An analysis of the plotted directional diagrams and transmission characteristics with various receivers indicates that the radiometer sensitivity is basically uniform but depends on the aberration and on the spectral range of the optical system. Shifting the shutter away from the focal plane or increasing its size beyond a certain diameter causes the sensitivity field to blur at the edges, where the sensitivity will depend on the nonuniformity of the receiver pad. It appears possible to reduce the differences in transmission characteristics, with only a small sacrifice in sensitivity, by a matched selection of receivers with approximately similar directional diagrams. Figures 2; references: 1 Russian.
[92-2415]

A STANDARD RADIATOR FOR CALIBRATION OF PYROMETERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 10, Oct 80 pp 41-43

CHISTYAKOV, V. A. and GAVRISHCHUK, V. I.

[Abstract] The "Repid-1M" standard radiator with automatic temperature regulator has been developed for calibration of pyrometers operating in the 300-1000°C temperature range and 1-5 μm spectral area. The radiator is a model of an absolutely black body with a cylindrical radiating cavity 80 mm in diameter and 430 mm in length. The cavity is a ceramic tube with a barrier of oxidized nickel. The barrier forms the bottom of the cavity. One main heater and two supplementary heaters are wound around the tube. There is a slot in the wall of the tube containing a three-junction differential thermocouple. Two of the junctions are located next to the additional heaters. The main heater is controlled using the central junction of the thermocouple and the main channel of the regulator. The current in the two other heaters, intended to equalize the temperature field of the radiator, is regulated based on the difference of the thermal emf in the central and outer junctions of the thermocouple, using the two differential channels of the regulator. The effective radiating capacity of the radiator was calculated by the method of Sparrow as improved by Bedford and Ma. During the calculations, the integral and spectral effective radiating capacities of the radiator were determined at operating temperatures of 300, 700 and 1000°C. The integral effective radiating capacities of the wall and bottom at 300, 700 and 1000°C were 0.7 and 0.45; 0.53 and 0.84; and 0.48 and 0.9. The table below presents the calculated spectral effective radiating capacities for the side-walls of Al_2O_3 and the bottom of N10 for wavelengths of 1, 3 and 5 μm :

$\lambda, \mu\text{m}$	$\epsilon\lambda$					
	Al_2O_3			N10		
	300° C	700°C	1000°C	300°C	700°C	1000°C
1	0.40	0.40	0.11	0.80	0.85	0.93
3	0.50	0.52	0.13	0.75	0.77	0.83
5	0.75	0.88	0.63	0.70	0.71	0.77

The mean square deviation from the mean value of temperature of the radiator was also determined, and was not over 2 K throughout the entire operating range of the radiator. Figures 3; references 6: 4 Russian, 2 Western.

[84-6508]

MEASUREMENT OF ELECTROMAGNETIC PARAMETERS OF FERRITES AT MICROWAVE WAVEBAND BY THE METHOD OF COMPARISON

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 10, Oct 80 pp 58-60

IVASHCHENKO, P. A. and SOKOLOV, V. M.

[Abstract] The dielectric and magnetic permeability of ferrites at microwave waveband can be measured by resonance methods using specimens, the dimensions of which are small. These methods have a number of shortcomings, however. This article suggests a method which does not have the shortcomings of the earlier methods: the permeability of ferrites is determined by comparison of the parameters of a resonator containing the model studied to the parameters of the same resonator in which a specimen of material is placed, with dimensions as close as possible to those of the specimen. This achieves a very small change in losses within the walls of the resonator, which determines the error in measurement of $\tan \delta_\epsilon$ and $\tan \delta_\mu$ and simplifies calculation equations. Specimens of dielectrics with low losses in which ϵ can be measured with high accuracy and $\mu/\mu_0=1$ are most suitable as standards. Cylindrical resonators 46 mm in diameter were used in experiments to reproduce the method in the 3-centimeter waveband. As an example, the results of measurement of the parameters of a type 90SCH ferrite are presented: $\epsilon'=13.84\pm0.07$; $\tan \delta_\epsilon=(8\pm2)\cdot 10^{-5}$; $\mu'=0.986\pm0.006$; $\tan \delta_\mu=(5\pm2.5)\cdot 10^{-5}$. Experiments showed that the results of measurement remain practically unchanged if the disk-shaped specimens are replaced by plates of different shapes which fully cover the cross section of the resonator. Figures 1; references 12: 11 Russian, 1 Western.

[84-6508]

A PROCEDURE FOR ESTIMATING THE NUMBER OF MULTIELECTRON SCINTILLATIONS FROM THE ACTIVE SCREEN SURFACE OF AN ELECTROOPTICAL IMAGE CONVERTER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 80 pp 14-16
manuscript received 20 Dec 79

ARKHIPOVA, T. A., BELOSHEYEV, V. K., BUTSKIY, V. V., GUTORENKO, O. M. and KUPTSOVA, G. Z.

[Abstract] Image conversion in television systems and image amplification in astrophotography with electrooptical devices requires the smallest possible number of bright spikes on the screen. Multielectron scintillations, which cause these spikes, increase the false-alarm probability and lower the threshold sensitivity. Here a procedure is described for measuring and estimating the distribution of scintillations over the active screen surface of an electrooptical converter. The instrumentation consists of a light source, a movement with a light-activated diode, image

transfer optics, two stops, a preamplifier, a main amplifier, an integrator with a linear bandpass output filter and a control circuit, a discriminator, a frequency meter, and a multichannel pulse amplitude analyzer. Experimental data indicate that the distribution of scintillations is axisymmetric and thus needs to be estimated along the radius only, from measurements around annular zones and through statistical analysis based on comparison with a normal distribution. Typical results are shown obtained with experimental data on dark scintillation from level 5 at the photocathode and ambient scintillation from level 10 under background illumination. Figures 3; references: 2 Russian.
[98-2415]

UDC 621.383.71:621.362

USE OF HEAT PROBES FOR RECORDING OF WEAK INFRARED PULSE SIGNALS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 9, Sep 80 pp 34-36
manuscript received 16 Feb 79

MATVEYEV, I. N. and RUBTSOV, V. A.

[Abstract] Various devices are used for recording of weak infrared pulse signals submerged in ambient noise. Here their performance characteristics are comparatively analyzed. Uncooled photoelectron multipliers feature a low intrinsic noise, Johnson noise in the resistor, and a nonselective spectral sensitivity. Uncooled bolometers have a higher conversion efficiency but a lower threshold sensitivity. Cooled photoresistors with extrinsic conductivity (Ge:Hg) or intrinsic conductivity (HgCdTe) are better detectors of $\lambda = 10.6 \mu\text{m}$ radiation. Other performance characteristics include the thermal time constant and the resolution. A high threshold sensitivity and a high response speed are attainable, without decrease of the signal-to-noise ratio, using cooled semiconductor-type bolometers with an auxiliary pulse being formed, the trailing edge of which duplicates the probe response and the leading edge corresponds to the prescribed risetime. This pulse is subtracted from the probe output pulse and the resulting difference pulse is compared with the threshold. Tables 1; references 11: 8 Russian, 3 Western.
[92-2415]

LINEAR PHOTODETECTORS WITH LOW-NOISE PHOTODIODES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 9, Sep 80 pp 8-11
manuscript received 1 Nov 79

TRISHENKOV, M. A.

[Abstract] The design and the performance of a linear photodetector, which usually consists of a photodiode and a preamplifier based on electron tubes or transistors, with matching circuits and with feedback, are analyzed here in terms of multiport network theory. General relations for signal and noise calculations are presented as a guide for applications requiring frequency correction as well as high sensitivity and stability such as in recording extremely low femtowatt (10^{-15} W) radiation power. Figures 1; references 9: 3 Russian, 6 Western (one in translation). [92-2415]

UDC 621. 397.274

SCANNING METHODS FOR MEASUREMENT OF THE ANGULAR COORDINATES OF A POINT SOURCE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 80 pp 8-11
manuscript received 8 Oct 79

FEDOSEYEV, V. I., SABLIN, V. K. and OSIPIK, V. A.

[Abstract] The interference immunity and the accuracy of optoelectric angle measuring devices with a dissector are improved by the use of a small raster of a special shape. Here several methods of scanning with various rasters are comparatively evaluated from the standpoint of accuracy. Any method of scanning requires formation of a mismatch signal along one of the coordinate axes at a time, for the purpose of which the video output signal from the dissector is passed through a linear filter and then through a limiter to a discriminator with two switches. From there the target signal proceeds to the "+" input or the "-" input of a subtractor, through the corresponding discriminator switch, depending on whether the center of the dissector aperture lies to the left or to the right of the raster axis. The difference or mismatch signal is fed to an integrator, the integration interval being equal to several scan periods. There is also synchronization provided in the system. A comparative analysis of fluctuations of the mismatch signal and the resulting error in its determination with various rasters and by various scanning methods reveals that, in terms of the relative rms error as a function of the noise-to-signal ratio, relay scanning is most accurate. A cruciform raster with either linear scanning or scanning along other than the principal axes is less accurate, and a rosette raster is least accurate. The accuracy of relay scanning can be improved by reducing the size of the aberration (blur) circle. Figures 4; references: 5 Russian. [98-2415]

USE OF NEMATIC LIQUID CRYSTALS FOR VISUALIZING SCATTERED ELECTRIC FIELDS OF MICRO-ELECTRONIC PRODUCTS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 444-449 manuscript received 11 Jul 79

GRITSENKO, N. I., KOVAL', Yu. D., MARKOVA, O. Z. and MOSHEL', N. V.

[Abstract] The operating conditions of integrated circuits can be studied successfully by an investigation of the distribution of scattered electric fields over elements under a specific potential. Nematic liquid crystals whose structure changes easily under the influence of external electric or magnetic fields can be used for checking the electrical operating conditions of integrated circuits. A study is made here of the behavior of nematic liquid crystals in electric fields of various configurations, in the presence and absence of current through the liquid crystal film, for the purpose of visualizing both variable and constant scattered electric fields of microelectronic products. As a rule the distribution of fields above integrated circuits is not homogeneous and is determined by the structure of the product and by the material of the integrated circuit's surface. The electrical conductivity of the surface determines whether the nematic liquid crystal can function in the conducting or nonconducting mode. Three main types of electric fields are illustrated: 1) The field of a flat capacitor; 2) An inhomogeneous field in which the dimensions of the potential surfaces are comparable with the distances between them; and 3) The field of a point charge, when these distances are considerably greater than the dimensions of the objects. Controlled birefringence is observed both in the presence and absence of current in a nematic liquid crystal and is evidenced in a change in the optical properties of the nematic liquid crystal film with the reorientation of anisometric molecules of the material under the effect of an electric field. The threshold voltage of the controlled birefringence effect is considerably lower than that for the manifestation of the dynamic scattering of light. A study was made of the dependence of these threshold voltages on the frequency of the field applied in plane cells of the sandwich type. Glass wafers with a semitransparent current-conducting film of SnO_2 applied to them served as the electrodes and an insulating layer of SiO_2 was applied in addition to the electrodes to enable the nonconducting mode for the nematic liquid crystal film. The initial homeotropic orientation of the liquid crystal film was set by means of surface-active materials. It was demonstrated that in a conducting model the reorientation voltage practically does not depend on the frequency. In a nonconducting model the same relationship is observed in the high-frequency region, but in the low-frequency region the threshold voltage increases with a reduction in frequency. It was demonstrated that if the duration of an external voltage pulse is longer than the total relaxation time of the nematic liquid crystal, illumination of the homeotropic film will be observed in crossed polaroids at the beginning and end of the pulse. Beginning at a certain

threshold frequency, with an increase in frequency constant illumination of the model is observed with the intensity of the light transmitted proportional to the voltage applied. Lecithin was used to produce a homeotropic orientation of the nematic liquid crystal on the surface of an integrated circuit. A lecithin solution was applied to the clean surface of the integrated circuit and the orienting film formed after desiccation of the solvent. A measured drop of liquid crystal was applied to the lecithin-coated surface and it was covered with a cover glass with a film of lecithin applied to it, in order to improve the homogeneity of the nematic liquid crystal film. The integrated circuit was placed in a holder with current-conducting contacts on the stage of a polarizing microscope. The homeotropically oriented nematic liquid crystal was reoriented under the effect of the field and against a dark background light regions reflecting the distribution of the electric potential on the surface of the integrated circuit were observed. Photographs are shown of the surface of a field-effect transistor in an IC (integrated circuit) with an applied film of nematic liquid crystal under various operating conditions. With careful preparation of the specimen it is possible to achieve resolution on the order of a few microns. The method described makes it possible to record constant and variable electric fields over a wide frequency range and to reveal defective sections of an integrated circuit, the boundaries of etching zones and oxide films and areas of discontinuity and damage in current-conducting and resistive films. The cost of the method is low, the technology is simple, and it is possible to observe electrical processes in an integrated circuit crystal directly under various operating modes of the circuit. Figures 5; references 10: 6 Russian, 4 Western. [35-8831]

UDC 621.372.81

ELEMENTARY CELL OF A PARALLEL MULTIDIGIT MULTIPLIER OF THE INTEGRATED INJECTION LOGIC (I^2L) TYPE

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 423-432 manuscript received 11 Jul 79

VARICHENKO, L. V. and LAPSHINOV, O. N.

[Abstract] Parallel matrix multipliers (PMU's) are constructed with matrices of elementary cells and are the fastest multipliers used in computers. Most LSIC (large-scale integrated circuit) PMU's operate with numbers represented in a binary alphabet, and with an increase in the number of digits of the multiplier and multiplicand the productivity of a PMU decreases. In addition, the limited number of output leads of the microcircuit's case limits an increase of the number of multiplier digits. These problems are solved by turning to a multidigit alphabet. It is demonstrated that the representation of numbers in a multidigit alphabet makes it possible to reduce the number of output leads of a large-scale integrated circuit and the number of connections between circuits, to reduce hardware costs and to improve the speed of response of a PMU circuit. The structure of an elementary cell of a matrix multiplier is discussed. The matrix of a k -digit multiplier, where $k = 4$,

is shown, which performs an operation of the type 3211×1322 . An elementary cell of a parallel multidigit multiplier consists of a single-digit multiplier, two half adders and a three-input adder the result of whose sum does not go beyond the limits of the digital configuration. It is demonstrated that it is possible to use I^2L circuits for performing multidigit logic functions. The physical structure of a multidigit I^2L gate is somewhat complicated and there are heightened requirements for the gain of the base current. The parameters of the base elements of multidigit I^2L circuits are discussed and the requirements which must be fulfilled in order for these circuits to perform logic functions are indicated. In developing I^2L multidigit circuits it is necessary to select a physical structure for the I^2L gate which will make possible the maximum level of the threshold current and the gain of the n-p-n transistor. It is also necessary to use the most effective circuitry both for the base elements, the threshold detector and the current repeller, as well as for the multidigit circuit as a whole. A structural diagram is suggested for the elementary cell of a multidigit PMU consisting of a single-digit number multiplier, two half adders and a three-input adder. Two methods of designing an elementary cell of a PMU are discussed. One employs a combination I^2L multidigit circuit and the other a read-only memory. A table of comparative characteristics is given for an 8×8 -bit PMU employing binary, four-digit and 16-digit alphabets. These are compared in terms of number of external leads and I^2L gates and in terms of the PMU's delay. Augmentation of the digit configuration of the input alphabet involves a reduction in the number of I^2L gates, making it possible to reduce the number of connections between circuits, and on the whole improve the parameters of the PMU. However, this also involves higher requirements for parameters and for the fabrication technology of multidigit I^2L gates. Figures 7; references 6: 5 Russian, 1 Western. [35-8831]

UDC 621.382

SEARCH FOR NEW PHYSICAL PHENOMENA IN THE SOLID STATE FOR USE IN MICROWAVE ELECTRONICS (SURVEY)

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 4-11 manuscript received 26 Oct 79, after completion 13 May 80

VENDIK, O. G.

[Abstract] Further progress in microwave electronics depends largely on developments in IC technology and on development of an active general-purpose device capable of performing various functions, analogous to the MOS transistor in low-frequency electronics and to the film heterolaser in integrated optics. In the search for such a device several physical phenomena in the solid state have been considered which could serve as the underlying mechanism. These include charge-carrier waves and transit-time effects in a semiconductor plasma (avalanche-transit-time and Gunn-effect diodes), negative differential conductivity (GaAs traveling-wave transistor), acoustic waves in piezoelectrics, polarization waves in ferroelectrics, spin waves in ferrites, and superconductivity with the attendant Josephson effect in the weak link. Figures 3; references 23: 5 Russian, 18 Western (2 in translation). [93-2415]

SUBNANOSECOND-RANGE INTEGRATED CIRCUITS BASED ON GALLIUM ARSENIDE

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 387-400 manuscript received 13 Mar 80

KRAVCHENKO, L. N., SAPEL'NIKOV, A. N. and STAROSEL'SKIY, V. I.

[Abstract] Superfast-acting integrated circuits can be created by using gallium arsenide as a semiconductor, which has better electrophysical properties than silicon. An overview is given of the state of the art and the prospects for the development of integrated microcircuits based on gallium arsenide. The components of integrated circuits based on gallium arsenide are discussed, including Schottky diodes, field-effect transistors, Gunn-effect devices, resistors and capacitors. The most widespread planar designs of these components are illustrated and discussed. The quality of Schottky diodes is determined by their time constant, equal to the product of the barrier capacitance and the resistance of the base. To reduce the time constant it is necessary to reduce as much as possible the length of the barrier contact and the distance between ohmic and barrier contacts. Modern technology has made it possible to bring these measurements down to 0.5 and 1 micron, respectively. It is possible to improve further the quality of Schottky diodes by creating a low-resistance n^+ subfilm under the ohmic contact. The structure of a field-effect transistor with a Schottky gate is discussed. A problem in these devices is the considerable difficulty involved in producing an active region with a thickness of less than 0.5 micron with the required degree of homogeneity. Normally closed and normally open transistors are discussed. The speed of response of "ideal" normally open and normally closed transistors is identical. In real transistors normally open transistors have a somewhat slower speed of response but considerably better energy characteristics. The speed of response of Gunn-effect devices is determined by the time for the formation and dissipation of a strong electric field domain. These times can be reduced to a value on the order of 10 ps. Technological aspects of the fabrication of integrated circuits based on gallium arsenide are discussed. GaAs integrated circuits are created on the basis of epitaxial and ion-doped structures. An intermediate high-resistance buffer film 0.5 to 4.0 microns thick with an electron concentration of $n_0 < 10^{14} \text{ cm}^{-3}$ is grown between the substrate and active film in order to eliminate the harmful influence of a substrate containing undesirable impurities. The components of an integrated circuit are insulated from one another by the creation of mesa structures by means of the selective etching of working regions. The resulting plateau structure makes it difficult to establish reliable interconnections. A flat surface can be produced by bombarding the active film with protons through the mask of a photoresist. An illustration is given of the sequence of operations for fabricating integrated circuits based on field-effect transistors with a Schottky gate, employing the technology of ion implantation in a high-quality semi-insulating substrate. The employment of field-effect transistors with a heterojunction in integrated circuits is discussed as a promising trend, especially with regard to the ability to reduce the size of transistors. Problems in designing logic elements are discussed, with emphasis on the necessity of matching logic levels at the input and output. A table is given of the principal characteristics of logic elements based on Gunn-effect devices; these elements have maximum speed of

response. They are ideal for use in relatively large data processors, where they make it possible to reduce the size and complexity of integrated circuits. A silicon demodulator integrated circuit containing 175 active components and requiring power of 0.85 W can be replaced by a gallium arsenide circuit employing three Gunn-effect devices requiring total power of 0.235 W. It is stressed that work on the creation of integrated circuits based on gallium arsenide was begun comparatively recently and is now at the stage of laboratory investigations and the development of technological processes. Achievements by Hewlett Packard, TRW, Hughes, Plessey, Thomson CSF (France), Rockwell, Lockheed and McDonnell Douglas are discussed. It is concluded that at present gallium arsenide is the most promising material for creating integrated circuits for the subnanosecond and picosecond ranges. Major circuitry problems relating to the creation of gallium arsenide integrated circuits include the development of memory systems and the development of the principles of organizing gigabit-range large-scale integrated circuits and of methods of coupling individual integrated circuits and large-scale integrated circuits. The development of gigabit microelectronics based on gallium arsenide must proceed along the line of improving the electrophysical parameters of the initial gallium arsenide and the ion doping technology. It is also necessary on a wide scale to introduce electron beam lithography and plasma chemical and ion beam processes. Figures 5; references 60: 11 Russian, 49 Western. [35-8831]

UDC 621.382

RESISTIVITY OF THIN TUNGSTEN FILMS APPLIED BY SPUTTERING UTILIZING A DISCHARGE WITH OSCILLATING ELECTRONS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 467-470 manuscript received 29 Oct 79

KONONKOVA, N. N., REYKHRUDEL', E. M. and SMIRNITSKAYA, G. V.

[Abstract] A description and the results are given of a study of the dependence of the deposition rate and resistivity of tungsten films produced by sputtering in a discharge with oscillating electrons, on the temperature of the substrate, the bias potential and parameters of the discharge. Tungsten is representative of high-melting point metals whose use as films in microelectronics has created interest. NaCl glass served as the substrate. In the sputtering method employed the discharge burns under high vacuum and spraying occurs with mean free paths considerably longer than the distance between the target and substrate. The substrate is placed directly behind the anode in windows cut into it. In the spraying process the substrate is continuously exposed to electrons from the discharge. The electrons clean the surface of the film and improve adhesion. The system was evacuated to approximately 10^{-8} mm Hg and disk-type cathodes made of polycrystalline tungsten were sputtered in an argon discharge at an argon pressure of about $5 \cdot 10^{-5}$ to $3 \cdot 10^{-4}$ mm Hg. The tungsten cathodes contained less than one percent oxygen and 0.013 percent carbon. The substrate

was heated to 400° C before applying the films. The surface of the films was studied with a transmission electron microscope, showing that films less than 100 Å thick have a finely granular structure with grains measuring about 50 Å and in films thicker than 100 Å and less thick than 700 Å the grains measure 50 to 150 Å. The films have a polycrystalline structure representing the alpha phase of tungsten. The chemical composition of the films is close to that of the sputtered cathodes. The cathode sputtering rate increases, as does the deposition rate, with an increase in the power of the discharge. A rise in the temperature of the substrate results in an increase in the mobility of particles of the sprayed material and in a reduction in the deposition rate. A study was made of the nature of the change in resistivity over time under various conditions for the purpose of determining the resistance of the electrical properties of the films produced to the influence of the environment. Films greater than 250 Å thick are affected little by the environment. Films less than 100 Å thick are affected more heavily by the environment. This is caused by the heavy oxidation of thin films. The resistivity of films greater than 400 Å thick is several microohms-centimeters, which practically does not change with a change in temperature and is resistant to external influences. The authors sincerely thank Yu. A. Durasova, coworker of the Physics Faculty, Moscow State University, for assistance in measuring the thickness of films. Figures 3; references 4: 2 Russian, 2 Western. [35-8831]

UDC 621.382.2:621.372.837.4:621.317.35

RECOVERY TIME AND ITS RELATION TO THE MAXIMUM POWER OF SOLID-STATE MICROWAVE PROTECTIVE DEVICES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 12-19 manuscript received 6 Feb 80

LEBEDEV, I. V., ALYBIN, V. G. and NIKULIN, V. V.

[Abstract] Solid-state microwave protective limiting and switching devices differ from gas-discharge devices for these applications in that their maximum power depends not only on the thermal processes occurring during operation but also on the recovery time. Here the mechanism of recovery following the incidence of a pulse on a diode structure is analyzed qualitatively, assuming this pulse from a transmitter to be rectangular. Heating and losses are then also considered, as well as the temperatures and the temperature dependence of the voltage drop, in establishing the quantitative criteria of maximum permissible power. The dependence of this maximum power on the duration of the incident pulse is calculated accordingly and put in the form of an exponential relation. Other performance parameters are determined on this basis as well, including the dependence of the maximum permissible power on the housing temperature and from this relation, by extrapolation, the maximum permissible device temperature. With the aid of respective curves, both these quantities can now be determined through measurement. Figures 5; references 19: 10 Russian, 9 Western (1 in translation). [93-2415]

STRAY COUPLING IN HYBRID FILM MICROCIRCUITS WITH FINITE DIMENSIONS OF THE CASE

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 464-467 manuscript received 20 Jul 79

KONTOROVICH, M. I. and PUTILOV, B. A.

[Abstract] Hybrid film microcircuits have longitudinal and horizontal dimensions which are considerably longer than their vertical. Because of this the influence of a microcircuit's short side walls is usually disregarded in calculating stray coupling in a microcircuit with a metal case. However, it has been demonstrated that at distances greater than the height of the microcircuit, stray coupling can dominate, caused by the fundamental component of an electromagnetic field proportional to the mean vertical current. It is necessary to take into account the finite dimensions of the case even at the stage of formulating the problem of analyzing stray coupling, inasmuch as there is but slight attenuation of the fundamental component of the field with an increase in distance. The solution to this problem is discussed here, which makes it possible to estimate the influence of the dimensions of the case and the relative contribution of the quasi-static stray coupling usually taken into account. The general procedure employed is to make a comparative analysis of various instances of coupling by comparing the electromagnetic fields excited by various sources. The excitation is considered of an electromagnetic field inside the case of a microcircuit, by means of a film element positioned at a specific point and connected to the outside circuit by means of a thin vertical conductor of specific length. The conductivity of the case is assumed to be ideal and its inside space to be two-layered, making it possible to take into account the influence of the dielectric substrate. The Fourier method is applied individually to each region of the space and "joining" is performed at the interface. As a result a solution is arrived at in the most convenient form suitable for analysis in a quasi-static approximation when the wavelength is considerably longer than the case's height. This approximation is valid up to the centimeter band and assumes that all field components except the fundamental are attenuated extremely rapidly with distance. An experimental measurement of fields was made using a model of a film circuit measuring 180 X 96 X 8 mm. A 22KHz ceramic plate 2 mm thick served as the dielectric substrate. Employed as the field source and receiving element were a vertical pin with a disk, an ohmic resistance and wire loops of various sizes. Good agreement between the experimental and calculated data was obtained. It is demonstrated that at distances considerably longer than the case's height, stray coupling resulting from the fundamental component of the electromagnetic field dominates over the capacitive and inductive coupling usually taken into account. Disregarding the finite dimensions of the case in calculating the vertical electric field component, even in the direct vicinity of the source, results in an error of severalfold and this error grows larger with an increase in distance. Curves are given which illustrate the quasi-static capacitive field of a film element with intrinsic capacitance of 1 pF charged to a voltage of 1 V. It is obvious that the field of the mean current dominates here with an increase in distance equal to or greater than one to two times the height of the vertical conductor. Figures 1; references: 7 Russian.

[35-8831]

MACROMODELING OF ANALOG INTEGRATED CIRCUITS ON THE BASIS OF THE METHOD OF BASIC MODELS

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 413-422 manuscript received 6 Jul 79

ALEKSENKO, A. G. and ZUYEV, B. I.

[Abstract] In the automation of circuitry design, by macromodels are meant models of functional units of electronic circuits which reflect their essential characteristics but are considerably less complicated than complete models of them at the level of the components making up the circuit. The purpose of macromodeling is to improve the effectiveness of automated circuitry design systems in calculating circuits containing integrated circuits and in calculating large-scale circuits which contain redundant fragments. This is an important goal for analog circuits in view of the lack of mathematical apparatus such as that which exists for digital circuits. The electrical macromodels in existence at the present time do not cover all the types of analog IC's (integrated circuits) being produced nor do they always improve the efficiency of systems for the automation of circuitry design. A macromodeling procedure is developed here which makes it possible to develop effective macromodels for the automation of circuitry design. Indicators are introduced which make it possible to make a quantitative estimate of the efficiency of automated circuitry design (ASP) systems taking into account the information aspect of the design process. The throughput of an ASP system is defined as the amount of information on the behavior of a model of the object studied as represented in the printout and related to the operating time of the computer processor. In order to determine the throughput, a measure is established for the amount of information which the ASP system processes. For this purpose the structural theory of information is employed, used for the simplest estimate of the capabilities of information systems. This theory analyzes the discrete structure of data files and their measurement by a simple count of information elements (quanta) or by a combinatorial method which assumes highly simple coding of data files. A geometrical measure of information is discussed. The quantity of information is determined by determining the number of quanta contained in a geometrical model of the information complex. This quantity is termed the information capacity of a communication. A macromodel information capacity indicator is introduced for the purpose of studying the influence of using macromodels on the efficiency of ASP systems. Equations are derived for the throughput of the ASP system for a specific problem. Comparative characteristics are presented for the efficiency of the AROPS [automatic calculation of optimal parameters for circuits] ASP complex when using a complete equivalent circuit and macromodels. It is demonstrated that in the development of macromodels it is effective to employ a block structure for the macromodel, whereby each block models an individual characteristic or group of similar characteristics of the functional element, and to implement this block structure with a basic set of models oriented toward a specific class of electronic circuits and representing an expanded traditional set of elements of models of ASP systems. Macromodels should be written in a language similar to the system's input language in order to set up a library of macromodels which can be added to by users of ASP systems. It is recommended that analog integrated circuits

employ redundancy in terms of the number of components for the purpose of compressing data in synthesis of the structure of a macromodel. The effectiveness of the macromodeling procedure described and based on the method of basic models has been proven in analyzing various electronic circuits. A tenfold and greater improvement in the efficiency of the AROPS complex has been recorded in test problems. This figure is higher, the higher the level of integration of the functional elements for which macromodels are employed. Figures 4; tables 4; references 15: 11 Russian, 4 Western.
[35-8831]

UDC 621.382:681.142

MULTISECTIONAL MODEL OF AN INTEGRATED INJECTION STRUCTURE

Moscow MIKROELEKTRONIKA in Russian Vol 9, No 5, 1980 pp 433-443 manuscript received 13 Mar 80

VEKSHINA, Ye. V. and FURSIN, G. I.

[Abstract] Integrated injection logic (I^2L) circuits contain hundreds and thousands of components and their analysis by means of traditional modeling is costly in terms of machine time. Here a multisection model is discussed which takes into account the fundamentally two- or three-dimensional nature of an injection structure resulting from the "inverse" connection of the n-p-n switching transistor and the ordinarily used horizontal p-n-p current-driving transistor. The parameters of the model's components are found as the result of measurements according to the standard procedure or by means of numerical calculation of the fusion-drift equations directly, or of electrical and structural models of them. In order to construct a multisection model the integrated structure is broken down into sections horizontally. The minimum number of sections is the number of characteristic regions of the structure, each having its own electrical and physical analog. The maximum number of sections with which the accuracy of the calculation will be highest is determined by the capabilities of the computer program and by the capacity of the computer's memory. A distinguishing feature of the multisection model suggested is the fact that the horizontal p-n-p transistor is modeled by means of several multicollector and multiemitter transistors. The multielectrode transistors take into account the fact that each section of the emitter, or of the collector, is connected to all sections of the collector, or of the emitter, of the p-n-p transistor. Two elementary transistors in the model, whose emitters are located in one section and whose collectors in various sections, have different transfer coefficients and different carrier transit times. As a result, any part of the surface of a collector collects carriers from all sections of the surface of an emitter and the current injected by each part of the surface of an emitter has several components whose magnitudes are influenced by the presence or absence of latent films, the type of vertical insulating region, the rate of surface recombination and the like. By employing this principle for designing a multisection model and by adding resistors modeling the resistance of active

and passive regions of the injection structure it is possible to take into account its two- or three-dimensional nature. The parameters of the components making up the multisection model are selected on the basis of experimental data. The advantage of this model and of the method of selecting the parameters of its components is improved calculation accuracy and the fact that a minimum number of the elements is used in designing a large-scale integrated circuit. At the same time it is possible to make a comparative analysis of a great number of different injection structures and to select the optimal variant. It is demonstrated that by using a minimum number of test structures it is possible to determine from them with sufficient accuracy all the alignment parameters of elementary components. It is then possible by means of a computer to determine the static and dynamic parameters of I^2L gates with practically any geometry. A cross section is shown of a horizontal p-n-p transistor included in an injection structure, along with a multisection model of it, as well as a cross section and multisection model of vertical n-p-n transistors with a high-resistance p-type and n-type substrate included in an injection structure. The authors thank T. M. Agakhanyan, Yu. Ye. Naumov and K. O. Petrosyants for helpful discussion of the work. Figures 6; references 14: 8 Russian, 6 Western.

[35-8831]

UDC 538.574.6

ANALYSIS OF STARTING CURRENTS OF A REFLECTION-TYPE DIFFRACTION RADIATION GENERATOR

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 49-52 manuscript received 29 Jan 80

BALAKLITSKIY, I. M., VOROB'YEV, G. S. and TSVYK, A. I.

[Abstract] The starting characteristics of a reflection-type diffraction radiation generator are analyzed. Such a generator operates by the principle of multiple transit of an electron beam over a periodic structure inside a high-Q open resonator cavity. Here an electron ribbon beam without modulation is assumed to enter a resonator cavity containing a "comb" grating between two mirrors and a reflector behind, from which it returns with modulated density and velocity. The electromagnetic field inside this cavity is regarded as a superposition of standing waves. The interaction power between the initial and the first reflected beams is calculated in the given-field approximation, whereupon the starting current and the emission frequency are calculated from the equation of power balance. Both are found to depend on the transit angles and on the reflector voltage, at a constant accelerating voltage, this relation being either oscillatory or characterized by discrete bands depending on whether or not respectively the microwave output power exceeds the power of the reflected beam. The theoretical results correspond closely to experimental data. Figures 3; references: 3 Russian.

[93-2415]

UDC 621.373.12

CONTROL OF THE FREQUENCY OF AN ENSEMBLE OF AUTOOSCILLATORS WITH AN EXTERNAL RESONATOR

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 34-37 manuscript received 28 Jan 80

GRIGORASH, V. V.

[Abstract] A powerful, frequency-tunable microwave source of oscillations with stabilization of the carrier over the range of tuning can be made, using a system of mutually synchronized autooscillators coupled with an external, frequency-tunable resonator. This article analyzes the behavior of such a system as the external

resonator is tuned, the effectiveness and features of this method of control of the frequency of the system, and estimates the range of possible tuning in the system. It is assumed that the system consists of n identical single-loop autooscillators, coupled with each other and with the external oscillator resistively and symmetrically each to each. Equations are derived for the equiamplitude synphase steady operating mode of the system. The frequency characteristic of this system is obtained by analyzing the equations and constructing the regulation characteristics of the system. A study of the steady synphase mode demonstrates the conditions of its stability, related to the resistive conductance between the autooscillators. The parameter $\eta = K_{gr}/K$ is assumed to be less than 1, meaning that the regulation characteristic of the system has two symmetrically located hysteresis zones. One defines the maximum possible range of frequency tuning, called the retention band. It is concluded that the retention band is independent of the value of K in the first approximation, while the capture band, defined by the other hysteresis zone, increases smoothly with a decrease in K . With otherwise equivalent conditions, the retention band and capture band can be effectively and simultaneously increased by introducing strong resistive coupling between the autooscillators and the external resonator. The central portion of the regulation characteristic, defined by an equation presented in this article, within which optimal control and stabilization of the frequency of the set of oscillators by the external resonator is achieved, is the best area for control of the system. Figures 3; references 7: 6 Russian, 1 Western. [85-6508]

UDC 621.374.4

A TRANSISTOR OSCILLATOR FOR THE 3-CM WAVELENGTH BAND

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 79-80 manuscript received 24 Sep 79

GANZIY, D. D., MALYSHEV, V. A. and TOLOMANENKO, A. F.

[Abstract] A transistor oscillator for the 3-cm wavelength band is shown which features a low intrinsic noise and a high efficiency, up to 15% at 9.4 GHz. The latter is achieved by optimization of the parametric mode of operation, while stability against parametric self-excitation is ensured by insertion of lossy passive components in the phasing circuit. The 2T640-3 transistor is coupled to a waveguide segment through a microstrip and a stub. Also included is a ballast resistor, an inductive-capacitive supply circuit, an emitter circuit and a collector circuit, all assembled on a substrate. The performance is analyzed on the basis of a simple equivalent circuit diagram, and measured in terms of the output power as a function of the collector voltage at various values of the emitter current. The maximum power of 60 mW is obtained with a collector voltage of 18 V and an emitter current of 24 mA. With smaller emitter currents it occurs at lower collector voltages. Figures 3; references: 4 Russian. [93-2415]

A SEMICONDUCTOR OSCILLATOR FOR THE MILLIMETER WAVELENGTH BAND WITH AN OPEN RESONATOR CAVITY AND AN EXCITATION SYSTEM CONSISTING OF TWO BARS

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 82-83 manuscript received 28 Apr 79

BORODKIN, A. I. and SMORODIN, V. V.

[Abstract] A millimeter-wave oscillator consisting of a semiconductor diode as the active device and an open resonator cavity with a diffraction grating in the role of the tank circuit was described in 1979 by A. I. Borodkin et al. Here a new feature of such an oscillator with a quasi-optical resonator is described which reduces the diffraction loss, namely excitation of the resonator with only one element of a diffraction grating. This element consists of two bars in parallel between the plane mirror and the concave spherical mirror, its geometrical proportions designed for minimum diffraction loss: width of each bar $h \approx \lambda/2$ and their span $D \approx \lambda/2$. The diode is located half-way between these two bars inside the resonator cavity. Calculations show that a minimum threshold distance between the bars is required for excitation and that the output power will then reach its maximum at some optimum distance, both these distances depending on the distance between the mirrors. Calculations also show that the Q-factor and the output power of such an oscillator, as functions of the distance between the mirrors, are each much lower than with a full diffraction grating--except at some optimum distance which brings both excitation systems closer together in performance. Figures 3; references: 2 Russian. [93-2415]

UDC 621.383

ANALYSIS OF THE FREQUENCY AND TRANSIENT CHARACTERISTICS OF AN OPTRON MADE WITH A LIGHT-EMITTING DIODE AND A COMPOUND PHOTOTRANSISTOR

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10, Oct 80 pp 69-72 manuscript received 18 Jul 79

VOYNOV, V. P. and OLEKSENKO, P. F.

[Abstract] The frequency and transient characteristics of a common optron with an LED and a compound phototransistor are analyzed using the method of physical equivalent circuits. The matrix of resistances of the optron is then calculated and presented. The voltage and current, conductivity and resistance transfer coefficients are also calculated. The change in voltage across the active-capacitive load of the optron when a current step is applied to the input is calculated as an example of analysis of the transient processes in the optron. Experimental studies of the transient characteristics of optrons were performed, and the disagreement between experimental and calculated values was not over 20%. The AFC and PFC are calculated and the results of experimental determination of these two characteristics are compared to the calculated results. The equations derived allow the parameters of the transient and frequency characteristics of optrons to be related to the electrophysical properties of their elements. Figures 3; references 9: 8 Russian, 1 Western. [85-6508]

UDC 666.1.037.5

GLASS-TO-SILICON JOINTS IN GLASS-METAL INSTRUMENT HOUSINGS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 9, Sep 80 pp 32-33
manuscript received 13 Nov 79

KONDAKOVA, L. V. and MIKHAYLOVA, V. A.

[Abstract] Silicon is widely used for windows in infrared instruments such as Dewar flasks because of its excellent transmission characteristics, which can be extended to higher temperatures by coating the silicon crystal with a TiO_2 interference film. Here a technology is described which facilitates joining a cubic single crystal of black silicon to the heat resistant glass tube of a cylindrical housing. Before two transition tubes of different grades of glass with successively higher linear thermal expansion coefficients are inserted between the heat resistant glass tube and glass tube inside a heat conducting Covar ring, the silicon crystal is first bonded with a nitrocellulose solution to the end of the heat resistant glass tube so as to cover the cylinder and then, after drying, sealed to it by means of a high-frequency graphite heater rather than soldered to it with the not quite compatible grade 30 NKD alloy. This process yields joints which are vacuum-tight in helium under a high pressure (25 atm gage) as well as under atmospheric pressure. Figures 1.

[92-2415]

UDC 668.395.7(088.8)

USE OF ADHESIVES VK-28M AND VK-48 IN THE MANUFACTURE OF FIBER OPTICS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 80 pp 50-51
manuscript received 4 Mar 80

PETROVA, A. P., ROGOV, N. S., MARUKHLENKO, M. M. and GONCHAROV, A. V.

[Abstract] The manufacture of certain optical devices requires translucent adhesives capable of withstanding high temperatures. Two adhesives are adequate for such applications and feature excellent compatibility with optical fibers. They are VK-28M epoxide compound without solvent rated for -60 to +250°C (200 h at 250°C, strength

130-150 kgf/cm² at 20°C and 65-75 kgf/cm² at 250°C), capable of withstanding mechanical stresses during grinding, and VK-48 rated for 400°C (strength 100-120 kgf/cm² at 20°C and 20-30 kgf/cm² at 400°C). Both grades have excellent optical characteristics and low rates of thermal aging (loss of transmittivity approximately 2% after 3 h at the top rated temperature). Tables 2; references: 3 Russian.
[98-2415]

MORE EFFECTIVE OPERATION OF RADIO EQUIPMENT MANUFACTURING ENTERPRISES

Moscow VESTNIK SVYAZI in Russian No 10, Oct 80 pp 37-39

LEDOVSKAYA, V. V., chief engineer, USSR Ministry of Communications, Central Administration of Space and Radio Communications, and PETROV, N. B., chief engineer, Labor and Wage Administration

[Abstract] An industry standard for radio equipment manufacturing enterprises which pertains to the production of television station and radio broadcasting transmitters as well as of radio trunk line equipment was put in effect on 1 October 1978. The purpose of the standard is to ensure economical use of labor and material as well as improvement of the psychophysiological environment in manufacturing plants, in terms of labor hygiene and work satisfaction. One important aspect of this standard is introduction of technological flow charts for systematic preventive inspection, measurement and alignment. Such charts have since been used in inspection of "Len," "Uragan," "Zona," "R-250 M," "UPV-15-1," "UPV-5" and other television transmitting equipment. The charts will also be used in alignment of "Len," "Sneg," "Dozhd'-2," "TUPV-0.25x2" and other television transmitting equipment. They are still being experimentally tested for inspection, measurements and alignment of "Zona-2" and "PTPV-500/250" television transmitting equipment. Another important aspect of this standard is attention to the work site and its organization for adaptation to new technological methods with attendant refurbishment in order to minimize fatigue and maximize safety and convenience. The Leningrad affiliate of the All-Union Scientific Research Institute of Engineering Aesthetics (L₁ VNIITE) as well as SUR-2 radio equipment manufacturing enterprises and their industrial institute participated in an analysis of this problem and the development of solutions. Accomplishments in this area include the design of a mobile test bay, a dolly with a turntable, a work bench, and cabinets for storing instrument, documents, and spare parts. More than 20% of the total cost reduction achieved in the year 1979 by the large enterprises of the radio equipment industry was due to improvement in the working conditions, which also made possible a relative reduction of the work force by 2996 units. Figures 6.

[95-2415]

THE EFFECT OF COHERENT MULTIPPOINT SIGNALS ON A SINGLE-PULSE DIRECTION FINDER

Moscow RADIOTEKHNIKA in Russian Vol 35, No 10. Oct 80 pp 27-29 manuscript received 3 May 79

DOBYKIN, V. D.

[Abstract] The antenna of a tracking single-pulse direction finder receives signals from a number of different points in space, not selected as to frequency, phase, amplitude or polarization. The spatial positions of the signal sources are known, fixed by the matrix $\Theta_{\Delta} = ||\Theta_{ji}||$, where Θ_{ji} is the angle between signal source j and signal source i from the phase center of the antenna. Matrix Θ_{Δ} is skew symmetrical. The problem stated is to find the spatial position of the antenna defined by the matrix column $\Theta = ||\Theta_j||$ of angles between directions to signal sources and the equal signal direction of the antenna. It is assumed that all of the sources are in a single plane to reveal better the regularities of the behavior of the direction-finding device. The most interesting case is that in which there is no resolution of the sources in terms of angular coordinates. Analysis of the spatial position of the signal sources indicates that the known angle Θ_{ji} consists of the difference of the desired angles $\Theta_{ji} = \Theta_j - \Theta_i$. The number of such relationships is equal to the number of elements in the matrix Θ_{Δ} , but only some of them are unknown. The problem is solved by fixing the unknown angle Θ_p and substituting into the equation for the identity of the sum and difference channels. This allows a compact expression to be found for the matrix of the desired angles. Numerical examples are appended. Figures 3; references: 2 Russian.

[85-6508]

RELATION BETWEEN SENSITIVITY AND EFFECTIVE RANGE OF AUTODYNE WITH RADAR PARAMETERS

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 28-30 manuscript received
25 Dec 79

TERESHCHENKO, A. F.

[Abstract] Because of the erroneous opinion that the effective range of autodyne systems does not depend on the probing signal power, which contradicts the general radar formula, the author attempts to discover the relationship between autodyne sensitivity and power, to disclose the effect of transmitter and receiver parameters on sensitivity, to find the dependences of the noise factor on sensitivity and effective range and on power, and thus to reconcile the concepts of autodyne and heterodyne operating modes in radar systems. The author proves the fact that the effective range is not an explicit function of power, because autodyne sensitivity is a generalized parameter, which characterizes simultaneously processes related to the generation and reception of HF energy with the same autodyne, utilizing the same non-linearity. An expression is derived for the effective range of an autodyne system as a function of autodyne power, expressed both directly through radiated power, and indirectly through the regenerative properties of the autodyne. The calculations may be used to determine the noise factor and transadmittance of an autodyne. Potentially large generators, operating in the low generation, or low power mode, may be used to increase the effective range and sensitivity of an autodyne. References: 4 Russian.

[69-7872]

RECORDERS

UDC 681.84.083.84

ANALYSIS OF PARAMETERS OF MAGNETIC RECORDING EQUIPMENT USING ELECTRONIC COMPUTER

Moscow RADIOTEKHNIKA in Russian Vol 35, No 9, 1980 pp 12-17 manuscript received 5 Dec 79

VICHES, A. I.

[Abstract] Because of the considerable difficulty of analyzing the basic parameters of magnetic recorded playback channels under operating conditions by direct optical and electrical measurement techniques, the use of modern computers, which perform direct input and processing of test signals and substantially reduce the difficulty of measurements and calculations, is examined. The technique provides an opportunity substantially to improve the completeness of an analysis and to determine not only the average parameters, but also the statistical characteristics of the most important parameters. The indirect technique, based on separation of the output signal of the induction playback head into two components--deterministic and random, is suitable for use under operational conditions. The purpose of measurement and analysis is to determine the random component as functions of the sought parameters and of the recording density. The random parameter is determined by the change of contact and random losses and by the change of the residual magnetization caused by the influence of the same losses during the recording process. An analytical equation is given, which expresses the desired signal components through wave models of losses. A test signal consisting of three harmonic components is utilized. The transcendental calculation equations can be solved by computer with sufficient accuracy by means of iteration. Approximate expressions are given, which yield satisfactory results. The calculation error does not exceed $\pm 10\%$. The calculation error decreases to 2-3% when the iteration method is used. A structural diagram of the measurement and processing of test signals, which can come from multifrequency signal generators, is presented. Primary processing of the signals consists in calculation of the instantaneous values of signal parameters based on the instantaneous values of the levels of the spectral components and determination of the estimated mean and mean square deviation of samples of the signals and calculated parameters, stored in the computer memory. Figures 3; references 13: 10 Russian, 3 Western.

[69-7872]

UDC 621.382.2.018.756

APPROXIMATE ANALYSIS OF THE GUNN-EFFECT DIODE OPERATING MODES

Kiev IZV. VUZ: RADIOELEKTRONIKA in Russian Vol 23, No 10, Oct 80 pp 61-63 manuscript received 17 Jan 80

TSARAPKIN, D. P. and KOZLOVA, Ye. P.

[Abstract] A new method is proposed for approximate analysis of the Gunn-effect diode operating modes, adequate for engineering design of oscillators and amplifiers. It is based on the integral equation of field intensity fluctuations in the one-dimensional model, reduction of this to an ordinary differential equation for the rate of change of the excess domain voltage, and extension of the latter from low only to high excess domain voltages also. The net current at any operating voltage is calculated from the cross-sectional area of the active layer, the electron drift velocity and the donor concentration, assuming the current to be subject to the law of continuity. The domain buildup over a wide dynamic range is calculated considering the effective domain field intensity as well as the instantaneous domain voltage and the excess resistance of the high-resistance layer. On this basis are then plotted curves of the hot negative conductance and the hot reactance as functions of the amplitude of the alternating component in the source voltage. The effect of the bias current can also be taken into account. Figures 2; references 7: 1 Russian, 6 Western.
[93-2415]

CSO: 1860

- END -

END OF

FICHE

DATE FILMED

3 / 4 / 81

